



User Guide

SK Pump



Software for
Commander SK

Part Number: SSK-0000-0001
Issue Number: 5

Safety Information

Persons supervising and performing the electrical installation or maintenance of a Drive and/or an external Option Unit must be suitably qualified and competent in these duties. They should be given the opportunity to study and if necessary to discuss this User Guide before work is started.

The voltages present in the Drive and external Option Units are capable of inflicting a severe electric shock and may be lethal. The Stop function of the Drive does not remove dangerous voltages from the terminals of the Drive and external Option Unit. Mains supplies should be removed before any servicing work is performed.

The installation instructions should be adhered to. Any questions or doubt should be referred to the supplier of the equipment. It is the responsibility of the owner or user to ensure that the installation of the Drive and external Option Unit, and the way in which they are operated and maintained complies with the requirements of the National Electrical Code and any additional state or local codes.

The Drive software may incorporate an optional Auto-start facility. In order to prevent the risk of injury to personnel working on or near the motor or its driven equipment and to prevent potential damage to equipment, users and operators, all necessary precautions must be taken if operating the Drive in this mode.

The Stop and Start inputs of the Drive should not be relied upon to ensure safety of personnel. If a safety hazard could exist from unexpected starting of the Drive, an interlock should be installed to prevent the motor being inadvertently started.

General Information

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive (Drive) with the motor.

The contents of this guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the contents of this guide, without notice.

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1 Introduction

1.1 Who Should Read This Manual?

This manual is intended to assist the user in commissioning the application software and should be read in conjunction with the documentation that is supplied with the drive and other associated hardware. The safety systems that are required to prevent risk of injury to persons operating or maintaining the machine are not included in this manual. The user must be familiar with and able to implement the required safety systems. This manual assumes that the user is familiar with relevant Control Techniques products and understands the requirements for the application.

If you do not feel confident of the above, then you should contact your local Control Techniques drive center or distributor to obtain assistance or service.

1.2 Application Overview

The SK Pumping Solutions drive is an effective and versatile control system for maintaining constant pressure or flow in a single pump configuration. An embedded controller in the motor drive eliminates the need for an external PLC saving cost, space, and programming time. The system consists of a Commander SK variable frequency motor drive with a SmartStick containing pump drive parameters, a LogicStick programmed with the pump solutions software, and an optional SM-I/O Lite module. The optional I/O module provides an additional 4 digital inputs for control purposes and 1 programmable relay output for status monitoring. See Section 5 *Electrical Installation* on page 15 for details.

The flexibility of the SK Pump drive allows the user to operate and run the pump from the built-in keypad without the need to interface with other control equipment. If additional functionality is desired I/O terminals may be utilized, including definable output status relays.

Pressure feedback can be provided via either a 4-20 mA analog signal or a pressure switch. The system will control based on pressure feedback alone or in conjunction with a flow switch.

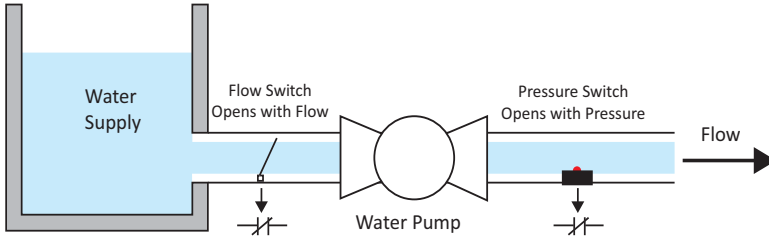
All models of the Commander SK drive are available with the Pumping Solutions control software.

NOTE

Only drive sizes B and above may have the optional SM-I/O Lite module installed.

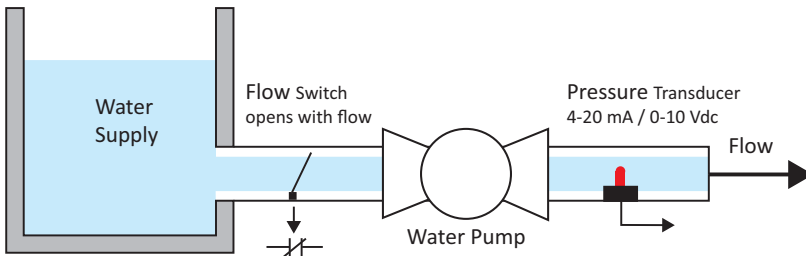
1.2.1 Pump Mode 1 (Pressure Switch Start / Flow Switch Stop)

In this mode, the pump starts automatically when low pressure is detected by the Pressure switch. The pump will then run at maximum speed. The pressure rises and the Pressure switch opens. If demand reduces (e.g. reduced flow due to valve closing) the pressure will increase and the Flow switch would close indicating a no-flow condition. At this point (no flow detection), the pump automatically stops after a adjustable time delay. This cycle is repeated when the pressure reduces to the low set level.



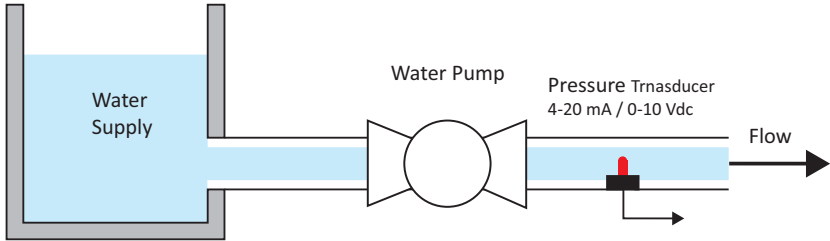
1.2.2 Pump Mode 2 (Pressure Transducer Start / Flow Switch Stop)

In this mode, the pump starts automatically after a adjustable start delay when a low pressure condition is detected (the transducer signal is below the Low Pressure setpoint threshold). Initially, a pipe fill operation is performed to remove air bubbles if enabled (then a constant pressure setpoint PID control regulates the system pressure to the setpoint). The pump control adjusts the motor speed in order to satisfy the demand and maintain constant pressure at the setpoint value. At maximum demand, the pump speed will be at maximum and whereas at low demand the motor speed drops to the minimum speed limit. If the demand goes even further below the system Flow switch will close indicating a no-flow condition. At this point (no flow detection), the pump automatically stops after a time delay.



1.2.3 Pump Mode 3 (Pressure Transducer Start/Stop)

In this mode, the pump starts automatically with a start delay when a low pressure condition is detected (Pressure Transducer signal goes below Low Pressure setpoint threshold). Initially, a pipe fill operation is performed to remove air bubbles if enabled. A constant pressure setpoint PID control then regulates the system pressure to the setpoint. The pump control adjusts the motor speed in order to satisfy the demand and maintain pressure constant at the set value. At maximum demand the pump speed will be at maximum speed and at low demand the motor speed drops to the minimum speed limit. The pump automatically stops after a time when a “No Flow” or “Sleep” condition is detected by the pump control system logic.



2 Ordering Codes

Any Commander SK drive model may be ordered with the Simplex Pumping software. There are two options available while ordering:

- (a) Commander SK Pump drive only
- (b) Commander SK Pump drive along with an SM-I/O Lite option module.

NOTE

All models of the Commander SK drive are available with the Pumping Solutions control software. Note that only frame size B and above may be filled with the optional SM-I/O module.

2.1 Pump Drive Only

Adding a suffix -P to any Commander SK model number specifies it as a pump drive. The Commander SK will be loaded with pump specific parameters. A pre-programmed LogicStick and SmartStick will accompany the drive. All control modes and pump specific features as described in Section 4 on page 11 (except the additional features mentioned in Section 2.2 on page 5) will be available with this option.

Example order codes: SKA1100025-P, SK2201-P, SK6401-P

2.2 Pump Drive with a SM-I/O Lite Option Module

Adding a suffix -PL with any Commander SK drive, frame size B or larger, specifies a pump drive along with an SM-I/O Lite module. The Commander SK is supplied loaded with pump default parameters, programmed LogicStick and a SmartStick loaded with the pump drive parameters for back-up. With this option, the additional I/O features available include:

- Multiple Setpoint Selection via 2 digital inputs (Mechanical Installation on page 11)
- Over temperature digital input
- Fault reset input
- An additional user programmable relay output

Example order codes: SKB1100110-PL, SK2201-PL, SK6401-PL

2.3 Programmed LogicStick and SmartStick

If you wish to convert an already purchased Commander SK into a pump drive, a programmed LogicStick-P is available as separate item. The order codes are: LogicStick-P, and LogicStick-PL.

The Commander SK drive parameters must be setup manually using CTSoft software or from the drive keypad with the default values listed in Section 10.1 on page 63 with a pre-configured SmartStick. The order codes are: SMARTSTICK-P for Pump Drive Only, and SMARTSTICK-PL for Pump Drive with an SM-I/O Lite option module.

NOTE

All models of the Commander SK drive are available with the Pumping Solutions control software. Only sizes B and above may be filled with the optional SM-I/O module.

The LogicStick-P is shipped with a SmartStick-P and the LogicStick-PL ships with a SmartStick-PL

2.4 How To Order

SK Pump Solutions can be ordered 4 ways:

1. Add a -P to the Commander SK drive order code
2. Add a -PL to the Commander SK drive order code (frame size B and above)
3. Order a LOGICSTICK-P
4. Order a LOGICSTICK-PL

2.4.1 Commander SK-P includes:

- A programmed Commander SK-P containing the default drive parameters for the Pump configuration.
- A LOGICSTICK containing the Pump software.
- A SMARTSTICK-P containing the default drive parameters for the Pump configuration. This is provided as a back up to restore drive parameter defaults.

2.4.2 Commander SK-PL includes:

- A LOGICSTICK containing the Pump software.
- A SMARTSTICK-P containing the default drive parameters for the Pump configuration. This is provided as a back up to restore drive parameter defaults.
- SM-I/O LITE option module (frame size B and above) parameters

2.4.3 LogicStick-P includes

- A LOGICSTICK containing the Pump software.
- A SMARTSTICK-P containing the default drive parameters for the Pump configuration.

2.4.4 LogicStick-PL includes

- A LOGICSTICK containing the Pump software.
- A SMARTSTICK-PL containing the default drive parameters for the Pump configuration including the SM-I/O Lite option module parameters.

3 Feature Set

The SK Pump Solutions drive incorporates several pumping specific control and diagnostic features that may be used or disabled depending on the application requirements. Following is a description of each attribute.

3.1 Operating Modes

When HAND or AUTO modes are not selected the drive is inhibited.

HAND Mode

When HAND mode is selected the drive immediately starts and commands the motor to run at a parameter specified fixed frequency. The pressure feedback transducer, pressure switch, and flow switch inputs are not monitored and the PID loop has no effect on operation.

AUTO Mode

In AUTO mode the drive starts, stops, and runs the motor based on one of the three options for the Start/Stop and Control mode set in Pr 63 (Pr 18.12). The three control mode settings are defined in sections Section 3.3.1 on page 8 through Section 3.3.3 on page 8.

3.2 Operating Mode Options

There are four operating mode options selectable by drive Pr 62 (Pr 18.11). The parameter setting defines how the drive is set to AUTO or HAND operation. Please see the Chapter 10 *Parameter Descriptions* on page 63 for setting details.

3.2.1 Off

The drive will not command a motor speed when Pr 62 (Pr 18.11) is set to this mode. Communication and I/O status are functional.

3.2.2 Terminals

When Pr 62 (Pr 18.11) is set for Terminals either the AUTO or HAND mode will be selected by turning on the respective digital input, B4 for AUTO mode or B5 for HAND mode. The modes are mutually exclusive.

3.2.3 Keypad-AUTO *

When Pr 62 (Pr 18.11) is set for Keypad-AUTO the drive will allow AUTO mode only. The drive will become active for operation by pressing the Run (green) push button on the keypad. Pressing the Stop button on the keypad will deactivate the drive and stop the motor.

3.2.4 Keypad-AUTO-HAND*

When Pr 62 (Pr 18.11) is set for Keypad-AUTO-HAND either the AUTO or HAND mode may be selected. Pressing the Run push button will activate the drive in AUTO mode. Pressing the Mode push button will activate the drive in HAND mode. The Stop push button will deactivate the drive from either mode.

NOTE "AUTO" can be used for Auto start. Auto start is not active in "HAND" mode.

"When the drive is active in either AUTO or HAND mode the Stop push button must be pressed to deactivate the mode prior to selecting the opposite mode.

* The SM-Keypad Plus does not support the keypad functions. Use the built in SK Keypad or the remote mount SK Keypad.

3.3 Start/Stop and Control Modes

There are three modes available to control the pressure and flow in the system depending on the type of feedback devices. Pr 63 (Pr 18.12) defines the mode to be used.

3.3.1 Pump Mode 1 - Pressure Switch and Flow Switch

The drive will become active and ramp up to maximum frequency when the Pressure Switch input turns on indicating low pressure. The drive remains active until either a Stop command is initiated or the system detects no flow from the Flow Switch input.

3.3.2 Pump Mode 2 - Pressure Transducer and Flow Switch

The drive will start the pump motor when the pressure transducer feedback value is below the Low Set-Point value in Pr 64 (Pr 18.13). The drive remains active until either a Stop command is initiated or the system detects no flow from the Flow Switch input.

3.3.3 Pump Mode 3 - Pressure Transducer Only

The drive will start the pump motor when the pressure transducer feedback value is below the Low Set-Point value in Pr 64 (Pr 18.13). The drive will run until a Stop command is initiated or a no flow situation is detected.

3.4 Software Operating Features

3.4.1 Pressure PID

In Pump Modes 2 and 3 the system water pressure is maintained by the drive using an adjustable gain PID control loop with a 4-20 mA pressure transducer as feedback. The user will enter the pressure setpoint in PSI units with 0.1 resolution and a range of 0-1000. The feedback transducer can be scaled using Pr 65 (Pr 18.23).

3.4.2 Sleep/Wake

In Pump Mode 3 only and during times of low demand it may be desired to stop the pump motor and enter a "sleep" situation. When the pressure drops the system will "wake" and resume pressure control. This feature may be used or disabled by setting Pr 67 (Pr 1.24) and Pr 2.17. If the motor frequency falls below the setting of Pr 67 (Pr 1.24) for the time specified in Pr 2.17 the system will initiate sleep. Setting Pr 67 (Pr 1.24) to 0 disables the sleep function.

3.4.3 No Suction Detection/Dry Well

While the motor is running at maximum speed the system will monitor the current load on the drive and determine if the pump is empty by comparing it to the normal running load as set in a Pr 2.26. If the motor load is below the setting for an amount of time specified in Pr 2.24 the system will reduce the speed or generate either an alarm or fault as selected by the user.

3.4.4 Transducer Loss Detection

The system will monitor the 4-20 mA pressure transducer and if the signal is below 4 mA the system will act as follows depending on a user setting in Pr 8.17: Option 1- the system will generate a trip, Option 2- the system will run at a fixed speed as specified by the user in Pr 1.27.

3.4.5 High Pressure Detect

There are separate parameters available for setting a high pressure warning alarm limit and a high pressure fault limit. If the actual system pressure exceeds the alarm setting in Pr **18.20** a digital output will be set. If the pressure exceeds the fault setting in Pr **18.21** the system will generate a trip. Setting parameter to 0 disables the function.

3.4.6 Low Pressure Detect

The system pressure is monitored while the drive is running at maximum speed. If the pressure is lower than the Main Setpoint for the amount of time specified by the user in Pr **2.16** the system will generate a trip. Setting parameter to 0 disables the function. An alternative option is by setting 18.50 =1, the user can specify a low pressure threshold set in Pr **18.14**.

3.4.7 Start Delay

In Pump Mode 1 the system will delay starting the pump motor until the Pressure Switch input has been on for the specified amount of time set in Pr **2.13**. In Pump Modes 2 and 3 the system will delay starting the pump until the pressure feedback falls below the Low Setpoint setting for the amount of time specified in Pr **2.13**. If the transducer signal level rises above the Low Setpoint value or the Pressure Switch input turns off, the timer will reset and the pump will not start. Setting parameter to 0 disables the Start Delay.

3.4.8 Stop Delay

In Pump Modes 1 and 2 the system will delay stopping the drive until the Flow Switch input has been closed for a time specified in Pr **2.14**. If the flow switch opens during this delay the timer will reset and the drive will remain active. Setting parameter to 0 disables the Stop Delay. Note: on Pump Mode 3 the stop delay is not used in this mode.

NOTE

The start/stop times should be set to reduce over cycling on the pump, when there is a low power and pressure condition.

3.4.9 Automatic Fault Reset

The system has the capability of automatically resetting trip conditions. A setting in Pr **10.34** allows the user to specify the number of reset attempts from 0 to 5 times. A setting of 0 disables the function. Pr **10.35** defines the time delay between the trip and the auto reset attempt. If the number of accumulated reset attempts reaches the value in Pr **10.34** no further reset attempts will be made. The reset attempt accumulation counter is reset to zero if no faults occur for 5 minutes, or if a manual reset is performed.

3.4.10 No Flow Detection

In Pump Mode 3 only and while running in AUTO mode the system monitors the speed of the motor and compares it to the setting in Pr **68** (Pr **1.26**) including the bandwidth set in Pr **1.23**. If the motor speed is lower for the period of time in Pr **2.23**, the system will begin the No Flow Detection sequence. First, the pressure setpoint will be decremented by the amount of PSI set in Pr **18.27**. After a stabilizing time set in Pr **2.18** the pressure feedback will be monitored to determine if the pressure followed the lower setpoint. If it did, the original setpoint will be restored. If not, a no flow situation is present and the system will initiate sleep.

3.4.11 Multiple Setpoint Selection

The system can store 4 separate pressure setpoints. Any of the 4 can be selected as the active setpoint via a binary pattern on two digital inputs on the SM-I/O Lite module. If neither of the inputs is turned on, the main setpoint value in Pr **66** (Pr **18.30**) is selected.

3.4.12 Pipe Fill

The Pipe Fill feature gives the user an option of bypassing the PID loop and running the motor at maximum speed for a specified amount of time when the drive starts running in automatic pump modes 2 or 3. When the timer has expired the drive will begin PID control. Setting a time value in Pr **2.15** will activate the feature, while a setting of 0 disables it. The No Flow, Under Pressure, and Dry Well detection will not be activated until the Pipe Fill timer has elapsed.



Use caution when activating this feature. The pressure transducer is ignored which may cause an over pressure condition if the time value is too long. When using this feature it is highly recommended to enable the over pressure fault detection.

4 Mechanical Installation

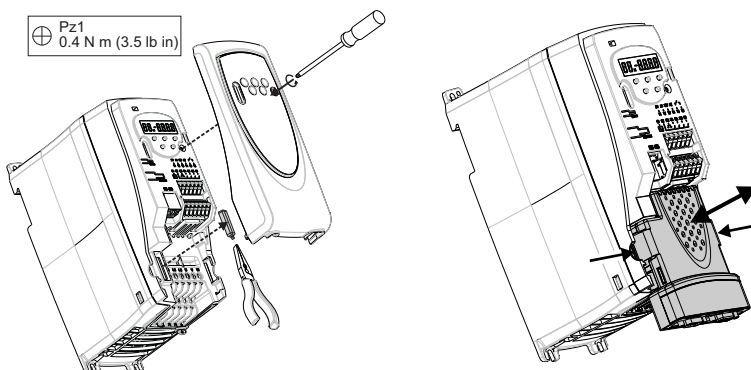
NOTE

Ensure the Commander SK is correctly installed in accordance to the Commander SK Installation Manual.

4.1 Option Modules Installation

Commander SK 'SM' option modules are truly universal and can be installed to the option slot provided on the drive. The following procedure is applicable for all the 'SM' option modules:

- Isolate the Drive from the main supply and allow 5 minutes for the DC Bus capacitors to discharge.
- Remove the terminal cover from the drive as shown below.
- Ensure that the plastic tab which covers the drive's Solutions Module connector is removed before installing any option module.
- Position the drive connector of the Solutions Module over the connector of the drive and push downwards until it locks into place. Make any wiring connections as appropriate.
- To remove the SM option module, press inwards at the points shown (side of the module) and pull in the direction shown.
- The drive must be disconnected from the mains supply before installing or removing an option module.

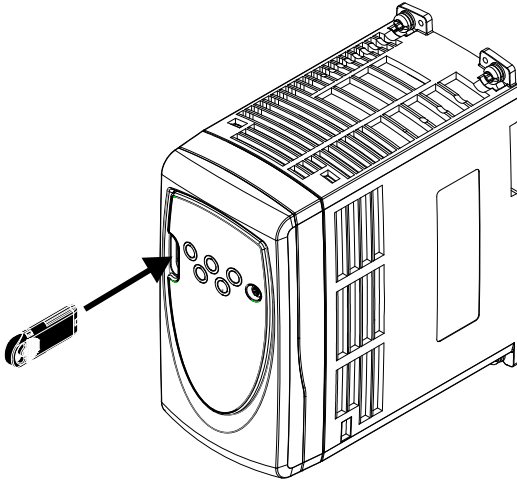


4.2 SmartStick Installation

The SmartStick is a memory option (flash drive) that stores a complete parameter set for the Commander SK.



1. Install the SmartStick into the drive SmartStick/LogicStick option slot with the copper tabs to the left.



The SmartStick is a parameter storage memory option that can be used to:

- Upload a parameter set from the drive
- Store a parameter set from the drive
- Automatically download a parameter set to the drive upon start-up
- Transfer a parameter set between drives

No	Function	Range	Defaults	Type
28	Parameter cloning	no,rEad, Prog, boot	no	RW

no: no action

rEAd: program the drive with the content of the SmartStick

Prog: program the SmartStick with the current drive settings

boot: SmartStick becomes read only. The contents of the SmartStick will be copied to the drive every time the drive is powered up.

NOTE

Before setting boot mode, the current drive settings must be stored in the SmartStick by using Prog mode, otherwise the drive will trip on C.Acc at power-up.

Parameter cloning is initiated by pressing the  MODE key on exit from parameter edit mode after Pr **28** has been set to rEAd, Prog or boot.

NOTE

If parameter cloning is enabled when no SmartStick is installed in the drive, the drive will trip on CAcc.

NOTE

The SmartStick can be used to copy parameters between drives of different ratings. Certain drive dependant parameters will be stored on the SmartStick but will not be copied to the cloned drive.

The drive will trip on C.rtg when being written to by a cloned parameter set of a different drive rating.

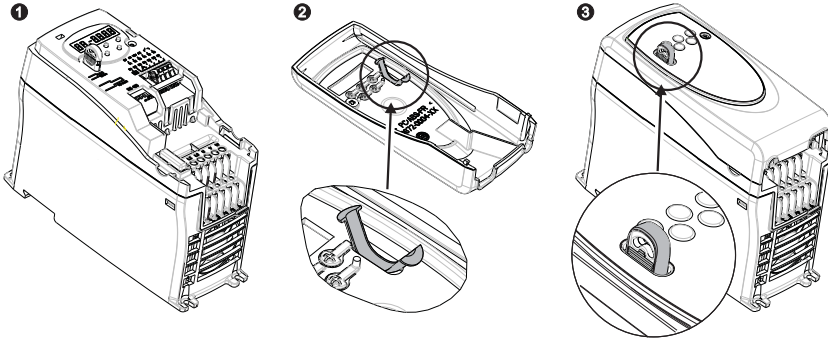
The drive dependant parameters are: Pr **06** Motor rated current, Pr **08** Motor rated voltage, Pr **09** Motor power factor and Pr **37** Maximum switching frequency.

4.3 Installation of LogicStick

The LogicStick is a memory option that stores a PLC ladder logic program to be executed onboard the drive.



1. Remove cover.
2. Install the LogicStick into the drive SmartStick/LogicStick option slot with the copper tabs to the left.
3. Press the LogicStick Guard into the LogicStick slot in the front cover as shown; do not press fully into position.
4. Install the terminal cover to the drive in the normal manner.



NOTE

The LogicStick may be inserted and removed from the drive while the power remains on. However, the drive will trip C.Acc (read / write fail) if the LogicStick is removed while it is being read/programmed during parameter cloning/transfer or the PLC ladder program is running.

5 Electrical Installation

Refer to the *Commander SK Getting Started User Guide* and *Commander SK Advanced User Guide* for proper mechanical and electrical installation of the drive and LogicStick. If using the SM-I/O Lite option module refer to the *SM-I/O Lite User Guide* for installation instructions.

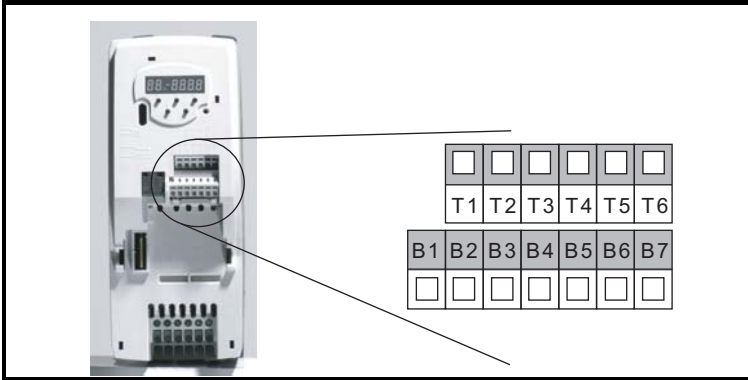
5.1 Control

All digital inputs on the Commander SK are positive logic only, meaning that connecting +24 Vdc to the input terminal will turn the input ON. Terminal B2 provides 100 mA at +24 Vdc.

All analog inputs on the Commander SK are unipolar only.

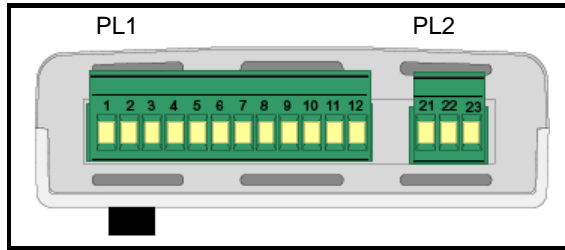
Detailed specifications for the I/O are listed in the Commander SK manuals.

5.1.1 Commander SK Control Terminal Connections



Term	SK Function	Pump Function
T1	0V Common	Pressure Transducer Common
T2	Analog Input 1	Pressure Transducer Input
T3	+10 Vdc Analog supply	+10 Vdc
T4	Analog Input 2 or Digital Input	Pump Fault Input
T5	Relay-Drive Healthy	Relay - Ready For Operation
T6	Relay-Drive Healthy	Relay - Ready For Operation
B1	Analog Output	Analog Output
B2	+24 Vdc Output	+24 Vdc
B3	Digital Output	Programmable Status Output
B4	Digital Input	AUTO Mode Select Input
B5	Digital Input	HAND Mode Select Input
B6	Digital Input	Flow Switch Input - Closed = No Flow
B7	Digital Input	Pressure Switch Input - Closed = No Pressure

5.1.2 SM-I/O Lite Option Module



Term	SK Function	Pump Function
PL1		
1	0V common	0 V
2	Analog Input	Over Temperature Switch Input - Close to Trip
3	Analog Output	Analog Output
4	+24 Vdc	+24 Vdc
5	Digital Input 1	Multi Setpoint Select 1 Input
6	Digital Input 2	Multi Setpoint Select 2 Input
7	Digital Input 3	Fault Reset Input - Close to Reset
8	Encoder B\	
9	Encoder A	
10	Encoder A\	
11	0V common (analog)	0V common (analog)
12	Encoder +5 V	
PL2		
21	Relay 1	Relay - Alarm
22	Not Connected	
23	Relay 2	Relay - Alarm

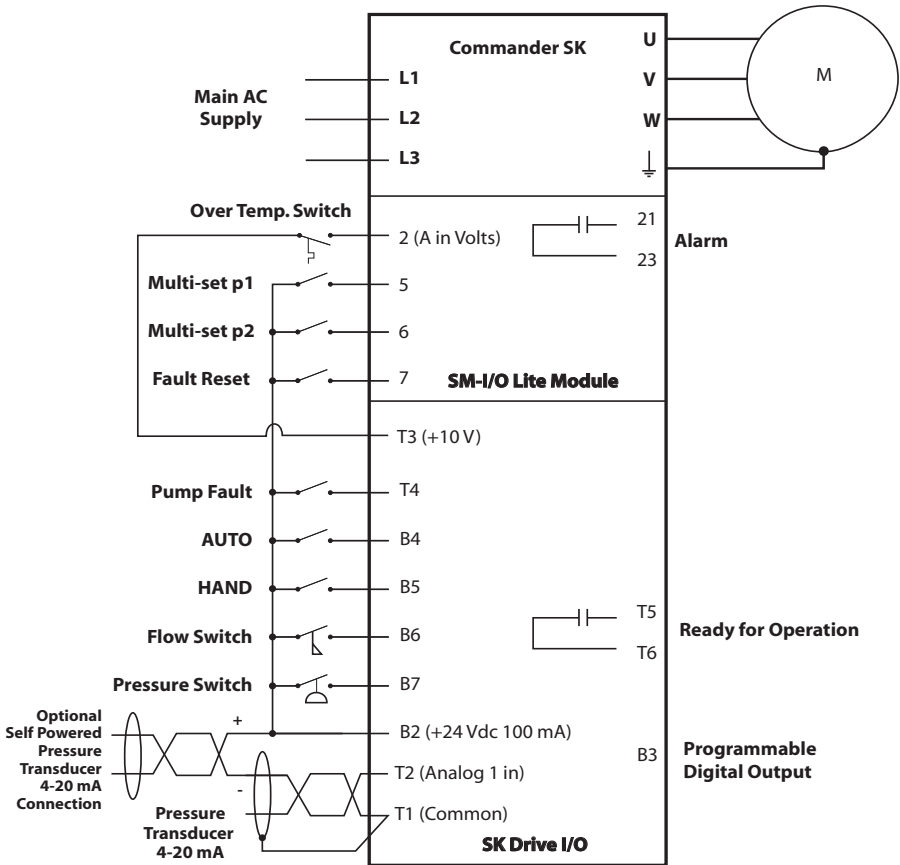
5.1.3 Commander SK RS485 Port



RJ45 Connector Pin out

Term	Function
1	Terminating Resistor
2	RX - TX EIA-RS485
3	0V
4	24 Vdc
5	Not Used
6	Tx Enable
7	/Rx - /Tx EIA-RS485
8	Linked to Pin 7

5.1.4 Typical System Wiring Diagram



NOTE:

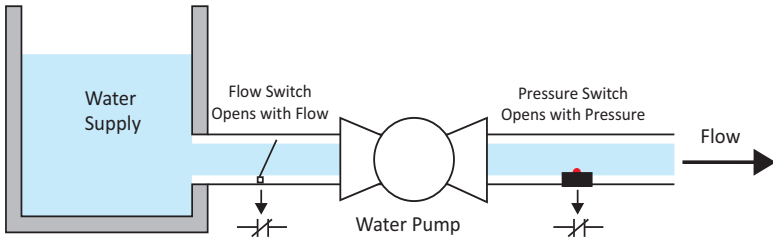
- Pressure Switch Input B7 only active in Pump Mode 1, Pr 73 (Pr 18.12) = 1
- Flow Switch Input B6 only active in Pump Mode 1 or Pump Mode 2, Pr 73 (Pr 18.12) = 1 or 2
- All outputs are programmable to indicate any alarm, trip or status

NOTE

Interposing relays should be used for drive I/O that is to be connected to remote devices.

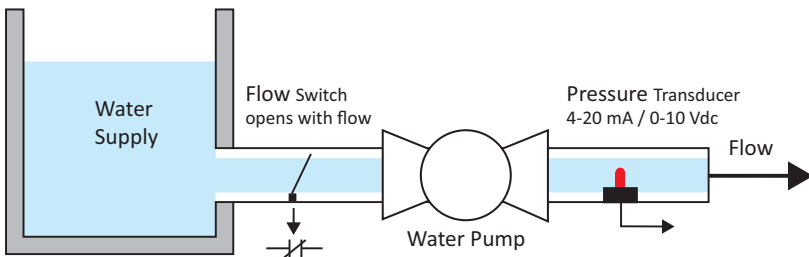
5.1.5 Pump Mode 1 (Pressure Switch Start / Flow Switch Stop)

This mode is selected by setting Pr 73 (Pr 18.12) = 1. In this mode, the pump starts automatically when low pressure is detected by the Pressure Switch. The pump will then run at maximum speed which is set in Pr 1.06. The pressure should rise and the Pressure Switch should open. If demand reduces, e.g. reduced flow due to valve closing, the pressure will increase and the Flow Switch (terminal B6) would close indicating a no-flow condition. At this point (no flow detection), the pump automatically stops after a adjustable time delay (Pr 2.14). This cycle is repeated when the pressure reduces to the low set level.



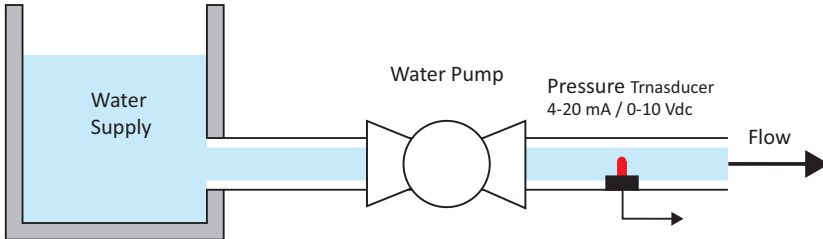
5.1.6 Pump Mode 2 (Pressure Transducer Start / Flow Switch Stop)

This mode is selected by setting Pr 73 (Pr 18.12 = 2) In this mode, the pump starts automatically with a start delay (Pr 2.13) when a low pressure condition is detected. The Pressure transducer signal Pr 71 (Pr 18.02) goes below the Low Pressure setpoint threshold (Pr 18.13). Initially, a pipe fill operation is performed to remove air bubbles if enabled. Then a constant pressure setpoint PID control regulates the system pressure to the setpoint. The pump control adjusts the motor speed in order to satisfy the demand and maintain pressure constant at the setpoint value. At maximum demand, the pump speed will be at maximum and at low demand the motor speed drops to minimum speed limit. If the demand goes even further below, the system Flow switch will close indicating a no-flow condition. At this point (no flow detection), the pump automatically stops after a adjustable time delay (Pr 2.14).



5.1.7 Pump Mode 3 (Pressure Transducer Start/Stop)

In this mode, the pump starts automatically with a start delay when a low pressure condition is detected (Pressure Transducer signal goes below Low Pressure setpoint threshold). Initially, a pipe fill operation is performed to remove any bubbles if enabled. A constant pressure setpoint PID control then regulates the system pressure to the setpoint. The pump control adjusts the motor speed in order to satisfy the demand and maintain pressure constant at the set value. At maximum demand the pump speed will be at maximum speed and at low demand the motor speed drops to minimum speed limit. The pump automatically stops after a time when a “No Flow” or “Sleep” condition is detected by the pump control system logic.



6 Getting Started

Several parameters must be set prior to running the Pump Solutions drive system. The drive may be commissioned by entering parameters with any of the following methods:

1. Use the drive's standard keypad. This method requires the use of Pr 71 to Pr 80 in order to gain access to all of the required settings. Set the parameter numbers whose values need to be changed in Pr 71 to Pr 80 and change the parameter value in Pr 61 to Pr 70. For example to set Pr 18.23 = 2000, set Pr 75 = 18.23 and Pr 65 = 2000. Once all setup parameters are entered, change the values of Pr 71 to Pr 80 back to the default setting shown in Section 6.1.1 on page 23. For more information on mapping, refer to *Commander SK Getting Started Guide*.
2. Connecting an SM-Keypad Plus to the standard RTU serial port. This LCD keypad provides direct access to all menus and parameters.
3. A personal computer with CTSOft drive configuration software and a CT communication cable connected to the standard RTU serial port. Cable order code is CT-USB-CABLE.

The screenshot shows the CTSOft software interface with the title bar 'CTSOft - My Project - [My Drive - Menu 2 - Ramps (Offline)]'. The main window displays a table of parameters for 'My Drive'. The 'Explorer' pane on the left shows a tree view with 'Menu 2 : Ramps' selected. The 'Toolbox' at the bottom contains buttons for 'Upload parameters', 'Download parameters', and 'Recal drive'.

Param. No.	Description	Default	Memory	Units
02.00	Parameter 0	0	0	
02.01	Post ramp reference	0.0	0.0	Hz
02.03	Ramp hold	OFF	OFF	
02.04	Ramp mode select	Std	Std	HV
02.06	S ramp enable	OFF	On	
02.07	S ramp acceleration limit	3.1	3.1	s ² /100Hz
02.08	Standard ramp voltage	375	775	V
02.10	Acceleration rate selector	0	0	
02.11	Acceleration rate 1	33.0	1.0	s/100 Hz
02.12	Acceleration rate 2	5.0	5.0	s/100 Hz
02.13	Start Delay Time	5.0	5.0	s/100 Hz
02.14	Stop Delay Time	5.0	5.0	s/100 Hz
02.15	Pipe Fill Time	5.0	0.0	s/100 Hz
02.16	Under Pressure Detect Time	5.0	0.0	s/100 Hz
02.17	Sleep Start Time	5.0	15	s/100 Hz
02.18	Stabilize Delay Time	5.0	2.0	s/100 Hz
02.19	Jog acceleration rate	0.2	0.2	s/100 Hz
02.20	Deceleration rate selector	0	0	
02.21	Deceleration rate 1	33.0	1.0	s/100 Hz
02.22	Deceleration rate 2	10.0	10.0	s/100 Hz
02.23	Constant Freq Time	10.0	5.0	s/100 Hz
02.24	Dry Well Detection Time	10.0	0.0	s/100 Hz
02.25	Deceleration rate 5	10.0	10.0	s/100 Hz
02.26	Speed / Torque Low Load Point	10.0	0.0	s/100 Hz
02.27	Frequency Decrement Low Sucti...	10.0	0.0	s/100 Hz
02.28	Deceleration rate 8	10.0	10.0	s/100 Hz
02.29	Jog deceleration rate	0.2	0.2	s/100 Hz
02.30	Acceleration selected indicator	0	1	
02.31	Deceleration selected indicator	0	1	
02.32	Acceleration select bit 0	OFF	OFF	
02.33	Acceleration select bit 1	OFF	OFF	
02.34	Acceleration select bit 2	OFF	OFF	
02.35	Deceleration select bit 0	OFF	OFF	
02.36	Deceleration select bit 1	OFF	OFF	
02.37	Deceleration select bit 2	OFF	OFF	
02.39	Ramp rate units	s/100 Hz	s/100 Hz	...

It is highly recommended to first become familiar with the commissioning method selected before proceeding to the set up steps in Section 6.1 on page 22.

6.1 Initial Set Up

Ensure that all digital inputs are off before applying power to the drive or changing any parameters.

Follow the steps below for the initial setting of the drive:

1. The SK Pump Solutions drive is shipped from the factory with the default pump parameters loaded. Apply power to the drive and verify that the pump specific parameter values match the default settings listed in Section 10 on page 63.
2. The pump parameters can also be programmed using a SMARTSTICK-P or SMARTSTICK-PL:
 - a Insert the SMARTSTICK into the SmartStick/LogicStick option slot
 - b Set Pr **28** = Read
 - c Press the RESET button on the drive keypad
 - d If the drive trips with 'c.rtg' code; the motor current rating needs to be set
 - e Press the RESET button again to clear the trip
3. Enter the motor data information from the motor data plate:
 - a Motor rated current in Pr **06**
 - b Motor rated voltage in Pr **08**
 - c Motor rated power factor in Pr **09** (if unknown leave at default of 85)
4. Enter motor rated full load RPM Pr **07** to a value of 0. This will ensure no slip compensation is enabled.
5. Ensure the pump program is running by setting Pr **59 (11.47)** = 1.
6. Scale the pressure transducer feedback signal connected to Commander SK analog input terminal T1 & T2. Set the minimum and maximum pressure values with Pr **18.22** and Pr **18.23** respectively. This applies to Pump modes 2 and 3 only.
7. The remainder of the parameter settings is application specific. The following sections in this chapter describe the parameter setup necessary for a particular feature.

NOTE

There are many other parameters available in the Commander SK drive and information on those can be obtained from the *Commander SK Advanced User Guide*.

6.1.1 Menu 0 Configurable Parameters

For ease of operation, the following 10 Menu 0 parameters are configured in the pump program:

Parameter	Description	Mapped Parameter
71	Pr 61 Set-up	18.02
72	Pr 62 Set-up	18.11
73	Pr 63 Set-up	18.12
74	Pr 64 Set-up	18.13
75	Pr 65 Set-up	18.23
76	Pr 66 Set-up	18.30
77	Pr 67 Set-up	1.24
78	Pr 68 Set-up	1.26
79	Pr 69 Set-up	14.10
80	Pr 70 Set-up	14.11

The above setup allows the following pump parameters to be viewed and setup from the base drive keypad Menu 0.

Parameter	Description	Type	Default	Units
61	Pressure Feedback Value (Pr 18.02)	RO	0	0.1 PSI
62	Pumping Macro Select (Pr 18.11)	RW	0	-
63	Start / Stop Control Modes (Pr 18.12)	RW	3	-
64	Low Setpoint (Pr 18.13)	RW	0	0.1 PSI
65	Maximum Feedback Scaling (Pr 18.23)	RW	1450	0.1 PSI
66	Main Setpoint (Pr 18.30)	RW	0	0.1 PSI
67	Minimum Sleep Speed/Freq (Pr 1.24)	RW	0	Hz
68	No Flow RPM (Freq) Setpoint (Pr 1.26)	RW	0	Hz
69	PID Proportional Gain (Pr 14.10)	RW	1	-
70	PID Integral Gain (Pr 14.11)	RW	0.5	-

See Diagram 15 Overview - Menu 0 on page 62 for more Menu 0 information

6.2 Sequence of Operation

The simplex pumping operation has 2 main control modes, HAND and AUTO. These modes can be selected from drive terminals or keypad or both as selected by 'Operation Mode' Pr **62** (Pr **18.11**). When HAND or AUTO mode is not selected the Pump drive is Inhibited/Off. The keypad displays 'inh' in this condition.

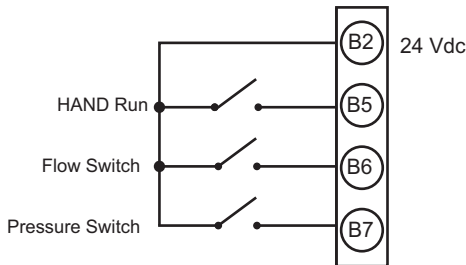
6.2.1 HAND Mode

This mode is mostly used for maintenance. The HAND mode can be selected from either the drive terminals or from the drive keypad. Relevant setup parameters for this mode are shown in the table below:

SK Parameter	Description	Section	Units	Range	Default
18 (1.21)	HAND Mode Speed (Frequency) Setpoint	6.2.1.1	Hz	+/- 1500.0	0
62 (18.11)	Pumping Macro Select	6.2.1.2	+/- 32767	0	0 (off)

6.2.1.1 From Drive Terminals

- Set the Pumping Macro Select Pr **62** (Pr **18.11**) = 1 (Terminals).
- Close the 'HAND' switch (drive terminals B2 and B5). The drive runs in HAND mode.
- Opening the 'HAND' switch will disable HAND mode and stop the drive.



6.2.1.2 From Drive Keypad:

- Set the Pumping Macro Select Pr **62** (Pr **18.11**) = 3 (AUTO + HAND).
- Press the keypad 'M' button to enable the HAND mode and run the motor
- Press the keypad 'STOP' button to disable the HAND mode and stop the motor

In HAND mode, the drive will run the motor at the set speed determined by the frequency reference as set in Pr **18** (Pr **1.21**)



In AUTO mode, there are 3 pump start/stop control modes that can be selected by Pr **73** (PR **18.12**):

- (i) Pump Mode 1 (Pressure Switch / Flow Switch),
- (ii) Pump Mode 2 (Pressure Transducer / Flow Switch), and
- (iii) Pump Mode 3 (Pressure Transducer)

In these modes, the pump speed will be automatically controlled by the PID controller in order to regulate the setpoint pressure control (see Section 6.2.5 on page 34 for more information).

6.2.1.3 Transducer Calibration

Speed can be varied in HAND mode by changing the pump Pr **18** (Pr **1.21**). This can be used to calibrate the pressure transducer signal by running at a speed and comparing a calibrated pressure signal to Pr **61** (Pr **18.02**) (0.1 PSI).

Pr **18.22** and Pr **18.23** set the minimum and maximum range of the pressure transducers 4-20 mA signal. This range can be obtained from the transducer nameplate and adjusted to suit actual pressure measurement from calibrated meter/gauge. Refer to functional diagram on page 56 for more details.

NOTE There is NO AUTOMATIC PRESSURE CONTROL in HAND mode.

Parameter	Description	Section	Units	Range	Default
18.02	Pressure Feedback Value		PSI	+/- 32767	
18.22	Minimum Feedback Scaling		PSI	+/- 32767	0
18.23	Maximum Feedback Scaling		PSI	+/- 32767	1450

6.2.2 AUTO Mode

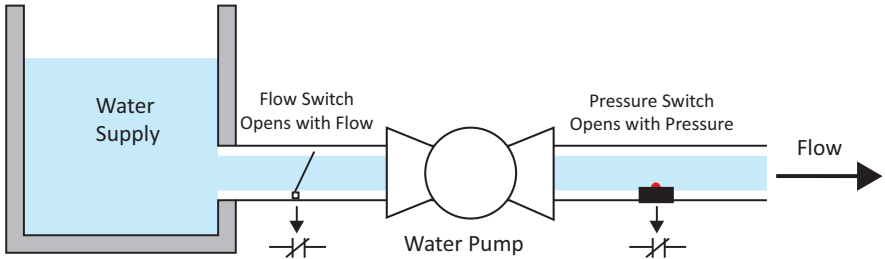
Setpoint PID pressure control is functional only in AUTO mode. The AUTO mode can be initiated from either the drive terminals or from the drive keypad. In AUTO mode, the pump start/stop sequence is automatically controlled based on the pump mode selected (refer to Section 6.2.3.1 on page 27, Section 6.2.3.2 on page 28 & Section 6.2.3.3 on page 30). Relevant setup parameters for AUTO mode are shown in the table below:

Parameter	Description	Section	Units	Range	Default
20 (1.23)	No Flow Frequency Bandwidth	6.2.3.3	Hz	+/-1500.0	15
21 (1.24)	Minimum Sleep Frequency*	6.2.7	Hz	+/-1500.0	0
1.25	Max Freq. Bandwidth	6.2.8	Hz	+/-1500.0	1
78 (1.26)	No Flow Frequency Setpoint	6.2.3.3	Hz	+/-1500.0	0
1.27	Feedback Loss Frequency Reference	6.2.5.4	Hz	+/-1500.0	
2.13	Start Delay Time	6.2.3.1 / 6.2.3.2 / 6.2.3.3	sec	0-3200.0	0
2.14	Stop Delay Time	6.2.3.1 / 6.2.3.2 / 6.2.3.3	sec	0-3200.0	5
2.15	Pipe Fill Time	6.2.6	sec	0-3200.0	0
2.16	Under Pressure Detect Time*	6.2.10	sec	0-3200.0	0
2.17	Sleep Start Time	6.2.7	sec	0-3200.0	0
2.18	Stabilize Delay	6.2.3.3	sec	0-3200.0	2
2.23	Constant Frequency Time	6.2.3.3	sec	0-3200.0	5
2.24	Dry Well Detection Time*	6.2.8	sec	0-3200.0	0
2.26	Torque Low Load Point	6.2.8	0.10%	0-3200.0	0
2.27	Frequency Dec. Low Suction	6.2.8	0.10%	0-3200.0	0
69 (14.10)	Proportional Gain	6.2.5.2	Gain	0-4.000	1
70 (14.11)	Integral Gain	6.2.5.2	sec	0-4.000	0.5
62 (18.11)	Pumping Macro Select	6.2.1.1 / 6.2.1.2		+/-32767	0
63 (18.12)	Start/Stop Control Modes	6.2.3.1 / 6.2.3.2 / 6.2.3.3		+/-32767	3
64 (18.13)	Low Setpoint	6.2.3.2 / 6.2.3.3	0.1 PSI	+/-32767	0
18.15	Setpoint Bandwidth	6.2.10	0.1 PSI	+/-32767	5
18.17	Transducer Loss Action*	6.2.5.4	0.1 PSI	+/-32767	1
18.18	Dry Well Selection Mode	6.2.8	0.1 PSI	+/-32767	2
18.20	Over Pressure Alarm Level*	6.2.9	0.1 PSI	+/-32767	0
18.21	Over Pressure Fault Level*	6.2.9	0.1 PSI	+/-32767	0
18.22	Minimum Feedback Scaling	6.1	0.1 PSI	+/-32767	0
75 (18.23)	Maximum Feedback Scaling	6.1	0.1 PSI	+/-32767	1450
18.24	Alternate Setpoint 1	6.2.5.1	0.1 PSI	+/-32767	0
18.25	Alternate Setpoint 2	6.2.5.1	0.1 PSI	+/-32767	0
18.26	Alternate Setpoint 3	6.2.5.1	0.1 PSI	+/-32767	0
76 (18.30)	Main Setpoint	6.2.5.1	0.1 PSI	+/-32767	0

6.2.3 Pump Mode Section

6.2.3.1 Pump Mode 1 (Pressure Switch Start / Flow Switch Stop)

This mode is selected by setting Pr 63 (Pr 18.12) = 1. Press Pressure Switch (Start) and Flow Switch (Stop) control.



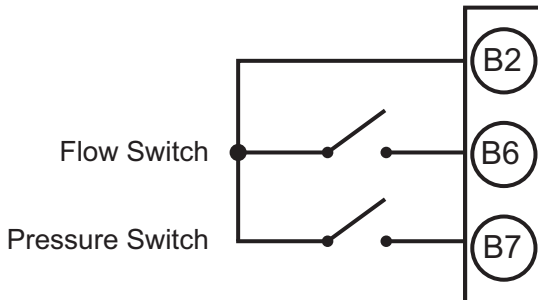
In this mode the pump will run based on the two switch inputs:

The Flow Switch (B6) and the Pressure Switch (B7).

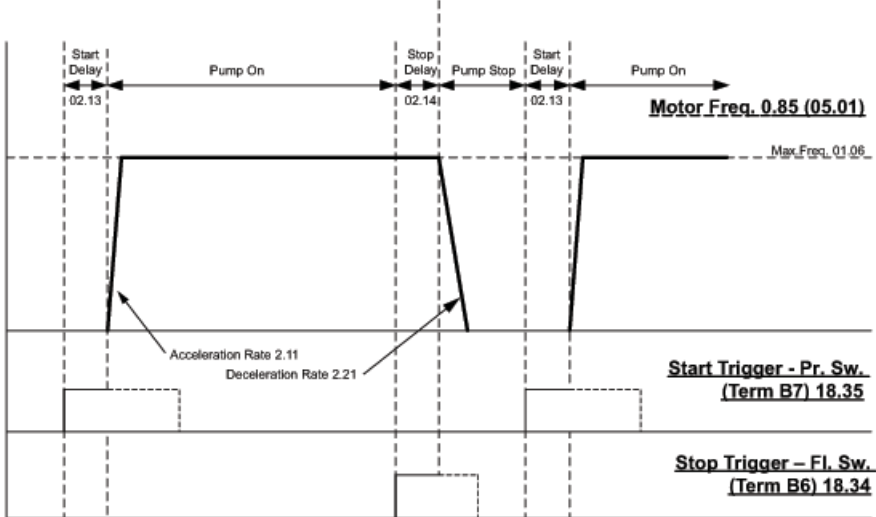
When the drive is placed in the AUTO mode, the display will switch from "ih" (inhibited) to "rd" (ready).

- At this point the pump will stay idle until the Pressure Switch closes (low PSI indicator) for a period of time set by Pr 2.13 (in seconds).
- Once the drive starts, it will ramp up to the maximum speed as set by Pr 02 (Pr 1.06) and stay there even if the Pressure Switch opens.
- The pump will continue to run until the Flow Switch closes (no flow indicator) for a period of time set by Pr 2.14 (in seconds).

Parameter #	Default Setting	Function
2.13	0 sec	Start Delay Time
2.14	0 sec	Stop Delay Time
02 (1.06)	60 Hz	Motor Max Frequency

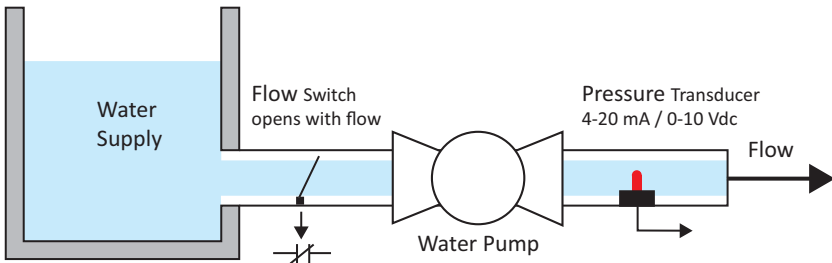


Pump Mode 1 Timing Diagram



6.2.3.2 Pump Mode 2 (Pressure Transducer Start / Flow Switch Stop)

This mode is selected by setting Pr 73 (Pr 18.12) = 2. Pressure Transducer (Start) and Flow Switch (Stop) Control.



In this mode the pump will run based on the two switch inputs:

The Flow Switch (B6) and the Pressure Transducer (B7).

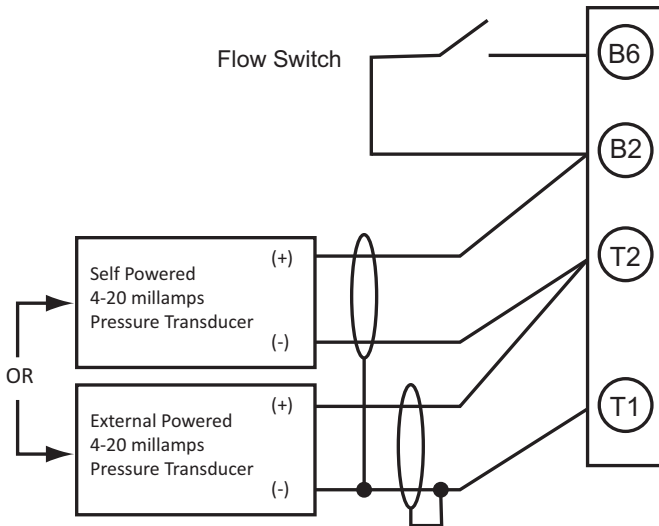
When the drive is placed in the AUTO mode, the display will switch from "ih" (inhibited) to "rd" (ready).

- At this point the pump will stay idle until the Pressure Transducer closes (low pressure indicator) for a period of time set by Pr 2.13 (in seconds).
- Once the drive starts, it will ramp up to the maximum speed as set by Pr 02 (Pr 1.06) and stay there even if the Pressure Switch opens.
- The pump will continue to run until the Flow Switch closes (no flow indicator) for a period of time set by Pr 2.14 (in seconds).

NOTE

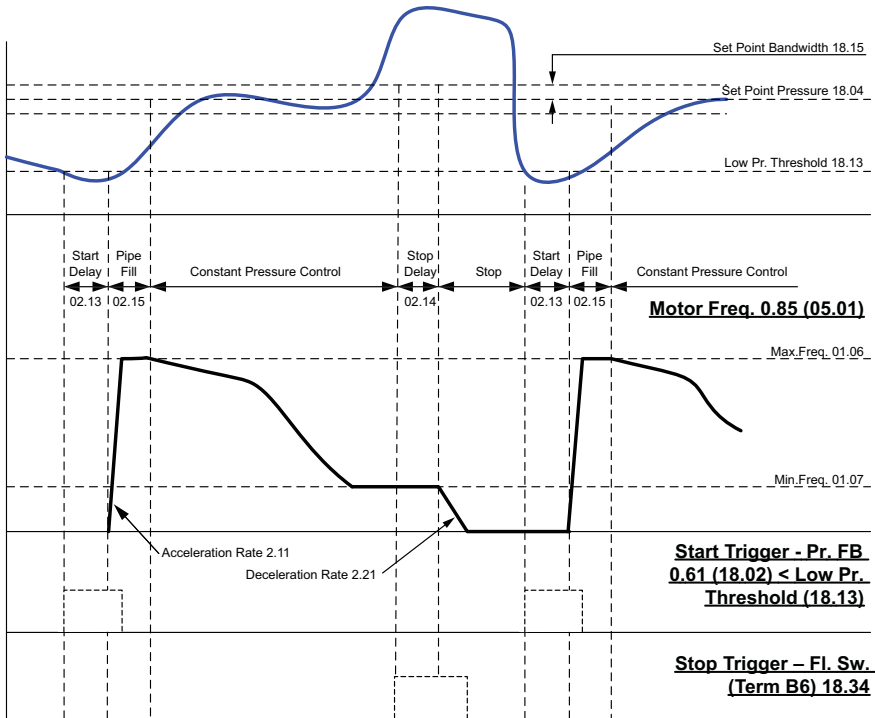
Care should be taken when setting the time since too long of a time could over pressure the system

Parameter #	Default Setting	Function
2.13	5 sec	Start Delay Time
2.14	0 sec	Stop Delay Time
64 (18.13)	0 sec	Min Pressure Threshold
2.15	0 sec	Pipe Fill Time
02 (1.06)	60 Hz	Motor Max Frequency



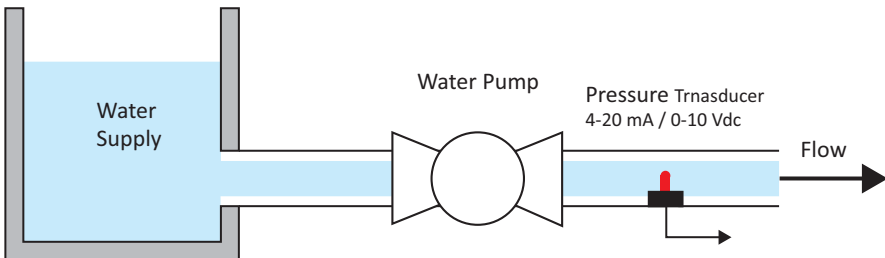
Pump Mode 2 Timing Diagram

Pressure Feedback 0.61 (18.02)



6.2.3.3 Pump Mode 3 (Pressure Transducer Only Control)

This mode is selected by setting Pr 73 (Pr 18.12) = 3. Pressure Transducer Start/Stop Control.



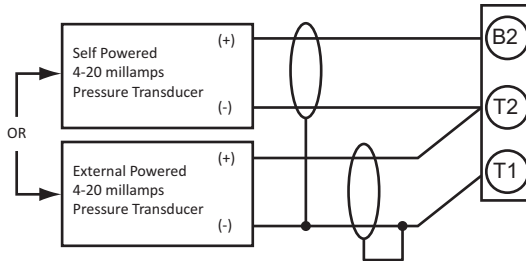
- In this mode of operation, the pump will start when the system pressure as measured by the transducer, Pr **61** (Pr **18.02**) falls below the minimum pressure threshold Pr **64** (Pr **18.13**) after a time delay, Pr **2.13**.
- The pump will continue to run until the No Flow condition is detected or a Sleep Mode occurs due to a lack of demand in the system.
- Also in this mode, a Pipe Fill Time function can be added. The time is set by Pr **2.15** and the pump speed is set by the maximum speed Pr **02** (Pr **1.06**). This function is to fill the empty pipe and remove any air bubbles.
- Sleep operation is detailed in the following section 6.2.4.

NOTE

Care should be taken when setting the pipe fit time since too long of a time could over pressure the system

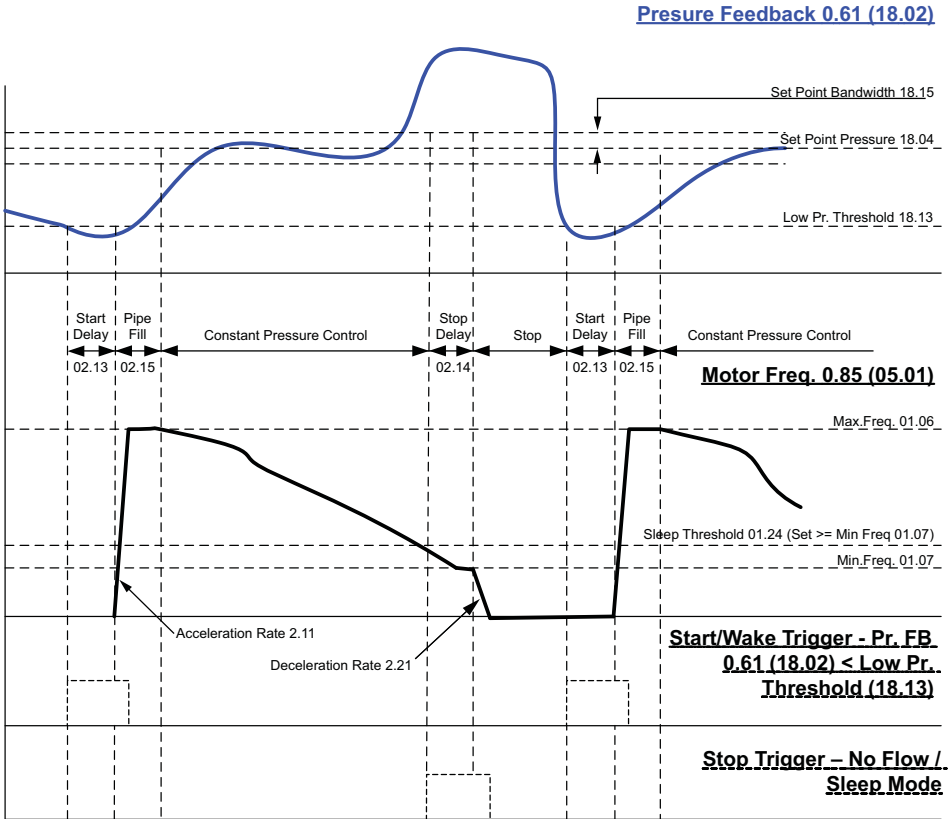
Parameter #	Default Setting	Function
2.13	5 sec	Start Delay Time
2.14	5 sec	Stop Delay Time ^a
64 (18.13)	0 sec	Min Pressure Threshold
2.15	0 sec	Pipe Fill Time
02 (1.06)	60 Hz	Motor Max Frequency

a. Based on Sleep or No Flow



The timing sequence diagram for pump mode 3 shown below is with 'Sleep' stop trigger logic,

**Pump Mode 3 Timing Diagram
(Stop Logic shown for Sleep Mode)**



6.2.4 Sleep and No Flow Modes

“Sleep Mode” is enabled by setting the Minimum Sleep Frequency, Pr 67 (Pr 1.24) to a non-zero value and a Sleep Time Delay in Pr 2.17. This function will put the drive into a ready “rd” state if the motor frequency drops below the minimum Sleep Frequency Pr 67 (Pr 1.24) must be set higher than the Minimum Frequency Pr 01 (Pr 2.07).

“No Flow” is enabled by setting the No Flow Frequency Setpoint, Pr 68 (Pr 1.26) to a non-zero value and a Duration Time in Pr 2.23. There is also a Frequency Bandwidth setting, Pr 1.23 and Stabilizing Time Delay set by Pr 2.18. This function will put the drive into a “rd” state if the motor frequency drops below the No flow Frequency setpoint for a period of time set in Pr 2.17. The No Flow Frequency Setpoint must be set higher than the Minimum Frequency Pr 01 (Pr 2.07),

and the frequency bandwidth setting (Pr **1.23**) must be greater than Pr **1.26** (NO Flow Frequency Setpoint) - Pr **1.07** (Minimum Speed).

Normally Sleep or No Flow would be used, not both.

Sleep Setup
(Mode 3 only)

Parameter #	Default Setting	Example Setting (pump)	Function
67 (1.24)	0 Hz	20 Hz	Minimum Sleep Frequency
2.17	0 sec	15 sec	Sleep Time Delay
01(1.07)	0 Hz	15 Hz	Minimum Speed Parameter

Normally Sleep or No Flow would be used, not both.

No Flow Setup
(Mode 3 only)

Parameter #	Default Setting	Example Setting (pump)	Function
68 (1.26)	0 Hz	20 Hz	No Flow Frequency Setpoint
2.23	0 sec	15 sec	Duration Time
1.23	0 Hz	6 Hz	Frequency Bandwidth
2.18	0 sec	15 sec	Stabilizing Time Delay
01 (1.07)	0 Hz	15 Hz	Minimum Frequency Parameter

Sleep logic: This condition is detected in Pump Mode 3 when the actual motor frequency goes below the Minimum Sleep Frequency Threshold Pr **67 (1.24)**. The pump will stop after a time delay set by Pr **2.17**. The parameter setting requirements for 'Sleep' condition detection is:

Minimum Sleep Frequency Pr **67 (Pr 1.24)** \geq Minimum Frequency Pr **01 (Pr 1.07)**

"No flow" detection logic: This condition is detected in Pump Mode 3 when the actual motor frequency (Pr **5.01**) goes below the 'No Flow Frequency Setpoint' Pr **68 (1.26)** and stays within a frequency bandwidth (+/- Window) set by Pr **1.23** for a time period (Pr **2.23**). There will be a stabilizing time delay as specified by Pr **2.18**. The parameter setting requirements for proper operation of 'No Flow' detection are:

No Flow Frequency Setpoint Pr **1.27** \geq Minimum Frequency Pr **01 (Pr 1.07)**

Bandwidth Pr **1.23** \geq (Pr **1.27** - Pr **01**)

6.2.5 Constant Pressure Setpoint Control

6.2.5.1 Pressure Setpoint Selection

The Pump System Setpoint (Pr **18.04**) sets the PID reference input for the pressure control system. The default setpoint is Pr **76** (Pr **18.30**) however, if multiple pressure setpoints are necessary, this can be achieved by adding an SM-I/O Lite module and using digital inputs T5 and T6 as shown in table below. These setpoint pressure must be less than the maximum rated value (Pr **75** (Pr **18.23**)).

Terminal 5	Terminal 6	Pump System Set-Point
Open	Open	Main Set
Closed	Open	Set-Point 1 (Pr 18.24)
Open	Closed	Set-Point 2 (Pr 18.25)
Closed	Closed	Set-Point 3 (Pr 18.26)

6.2.5.2 PID Pressure Control

The built in PID Controller within the pump drive regulates the pump pressure depending on the setpoint. The proportional Pr **69** (Pr **14.10**) and Integral Pr **70** (Pr **14.11**) gains may require adjusting to obtain the response required, however the default values are suitable for most systems.

6.2.5.3 Transducer Calibration

The SK Pump program must know the pressure range of the transducer. The minimum and maximum pressure is entered in the parameters listed below. Pr **7.05** (sets up analog input #1 (T2) for a 4-20 mA or 0 Vdc to 10 Vdc signal.

NOTE The units entered in **ALL** of pressure registers is the value in psi x10 since the units are tenths of a pound

Parameter #	Default Setting	Function
61 (18.02)	0000 psi	Pressure Feedback Value
65 (8.23)	0000 psi	Maximum Pressure Feedback
18.22	0000 psi	Minimum Pressure Feedback

Example: For a transducer rated at 200 psi maximum, enter $200 \times 10 = 2000$ into Pr **18.23** (as well as any other pressure parameter).

6.2.5.4 Transducer Loss (4-20 mA only)

In case of transducer feedback loss, one of the following actions is taken by the pump control system based upon the setting of Pr **18.17**.

0 = Disabled (Ignore fault)

1 = Fault Drive (Trip Code t081)

2 = Run at Fixed Speed set in Pr **1.27**)

When a 4-20 mA transducer is used (when is normally the case), the drive can be faulted or forced to run at a fixed speed (as set by Pr 1.27) if the transducer signal is lost (i.e. drops below 3.5 mA).

Parameter #	Default Setting	Function
18.17	1	0 = Disables 1 = Trip Drive (t081) 2 = Run at fixed speed (frequency)
1.27	0 Hz	Motor frequency when transducer signal loss

6.2.6 Pipe Fill Operation

This feature is designed to remove air bubbles from the pipe at the beginning of the pump fill operation in AUTO mode. The pump will run at the maximum speed for a duration set by Pipe Fill Time (Pr 2.15) after which the PID control will start.

6.2.7 Sleep Mode

When in AUTO mode, if the motor frequency command from the PID controller drops below Minimum Sleep Frequency Pr 67 (Pr 1.24) for duration set by Pr 2.17, sleep mode will be initiated. The drive will stop controlling the motor and will restart when the start criteria is met depending on the pump mode selected

6.2.8 Dry Well Detection

In AUTO mode if the actual Motor Frequency, Pr 85 (Pr 5.01), is within the maximum frequency window defined by Pr 1.25 and the motor torque (Pr 4.20) is less than the Torque Low Set point (Pr 2.26) for a time specified by Dry well detection time (Pr 2.24), then a dry well condition is sensed. Depending on the Dry Well Detection Mode chosen (Pr 18.18), the following actions are possible:

0 - Condition ignored

1 - Motor speed decreased by a percentage set by Pr 2.27

2 - Tripped with a fault code t084.

The SK Pump program can be setup to detect a Dry Well condition. In order to set up this function, the pump load at 60Hz must be determined. Pr 4.20 in the drive will display the motor / pump load while running.

The simplest way to do this is to run the drive in Hand mode and set the Hand Speed Pr 18 (Pr 1.21) to 60 Hz and observe the load. Be careful not to over pressure the system while performing this test. Assuming this load level measured is to 100%, the Low Load Set point Pr 2.26 needs to be set lower than 100%, say 80%.

If under normal running conditions (in AUTO Mode) the motor load drops below 80% while the drive is running at 100% speed for a time period set in #2.24, the drive will perform the function as selected by Pr 18.18 (see table above).

Parameter #	Default Setting	Function
#4.20	%	Motor Load in percent (RO)

#2.26	0%	Motor Load at Full pump Speed
#2.24	0 sec	Detection Time
#18.18	0	0 = Alarm 1 = Decrease pump speed (by % in Pr 2.27) 2 = Fault the Drive

6.2.9 Over Pressure Alarm/Trip

In AUTO mode the drive can detect two over pressure levels. The first (set by Pr 18.20) is used to set an alarm if the pressure stays at 95% of that level (a flag is set, Pr 18.41) which can be used for a digital output or relay output to indicate this alarm.

The second, set by Pr 18.21, will cause the drive to trip, displaying a t082 code on the drive display.

Parameter #	Default Setting	Function
#18.20	0%	Over Pressure Alarm Setting
#18.41	0	Flag parameter for Alarm
#18.21	0%	Over Pressure Trip Setting

6.2.10 Under Pressure Feedback Trip

When the pressure Pr 61 (Pr 18.02) is below the setpoint bandwidth (Pr 18.15) and the motor frequency is within maximum frequency bandwidth (01.06 - 1.25) for a duration more than Under Pressure Detect Time (Pr 2.16), the pump drive is tripped and indicates trip code t083.

There are 2 configurations available:

Pr 18.50 = 0 System Set Point Bandwidth

Pr 18.50 = 1 Under Pressure Setpoint

When the pressure Pr 61 (Pr 18.02) is below the under pressure setpoint (Pr 18.14) and the motor frequency is within the maximum frequency bandwidth (1.06 - 1.25), for a duration more than Under Pressure Detect Time (Pr 2.16), the pump drive is tripped with a trip code t083.

6.3 Manual Mode Start Up

Upon selecting manual mode the pump will run at a fixed speed specified in Pr 18 until the Hand input is removed (in terminal mode) or the stop button is pressed (in keypad mode).

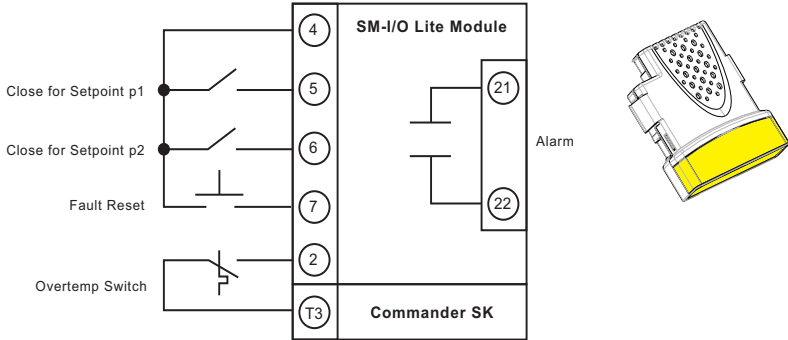
1. Ensure the pump is ready for operation.
2. Enter the desired motor frequency in Pr 18
3. If Pr 62 (Pr 18.11) is set to 1 (terminals) closing the Hand input will start the pump. Removing the input will stop the pump motor.

If Pr 62 (Pr 18.11) is set to 3 (Keypad AUTO + HAND) pressing the M button on the keypad will start the pump.

Press the Stop (red) button to stop the pump.

7 Additional Functions available with the SM-I/O Lite Module

An SM-I/O Lite Module can be added to the SK Pump system to provide additional system features. The drawing below illustrates them.



7.1 Additional Parameter Settings for the SM-I/O Lite Module

Parameter #	Default Setting	Required Setting	Function
#15.24	0	18.36	Terminal 5 on the I/O Lite module mapped to PID setpoint 1
#15.25	0	18.37	Terminal 6 on the I/O Lite module selects PID setpoint 2
#15.26	0	10.33	Terminal 7 on the I/O Lite module mapped to drive reset
#15.27	0	As required	Output Relay mapping Parameter
#18.30	0 psi	As required	Main PID setpoint (terminal 5 & 6 open)
#18.36	0 psi	As required	PID setpoint 1
#18.36	0 psi	As required	PID setpoint 2

NOTE

The units entered in all of the pressure registers is the value in psi x 10 since the units are tenths of a pound.

Example: For a PID setpoint of 100 psi maximum, enter $100 \times 10 = 1000$ into # 18.36 (as well as any other pressure parameter).

8 Backing-up The Set-up Parameters

After you have succeeded in setting up the SK Pump to your satisfaction, this setup data defines the essence of the application and allows the drive to perform as it was intended per your application. Should it become necessary to replace a drive, without this critical data, the drive would be unable to perform as it was originally intended.

NOTE

Control Techniques will be able to provide you with a replacement drive but we will not have the "recipe" (data) that was specific for your application. Therefore, it is imperative that the OEM, System Integrator, Field Engineer or Installer back up this critical information and leave a copy with the End User following the commissioning process. Failure to do so can result in unnecessary machine downtime.

8.1 SmartStick Method

A SmartStick is included with the Commander SK Pump which contains a default set of pump parameters depending on the -P or -PL suffix (the SmartStick-P and SmartStick-PL can be purchased separately). The data on this stick has been made "read-only" (boot mode) so it can always be used to get back to a factory default pump parameters if need be. In order to return the SK Pump drive back to factory settings you would first reset the drive to defaults (Pr 29 set to "usa", then push the stop / reset button), Pr 29 should revert back to "no" when the process is complete. Now power down the drive, insert the SmartStick then power the drive back up. The parameters will load automatically. Once this is complete, power down the drive and insert the LogicStick and power up the drive. Press the stop reset button once power up is complete. If you have an older SmartStick you may need to set Pr 28 to "read" then press the mode button (Pr 28 should revert back to "no").

The drive will now have all of the required default parameter settings. The program can now be set up for the application. Make sure the LogicStick program is running - Pr 59 = 1 and Pr 60 = 2.

8.2 CTSOft Method

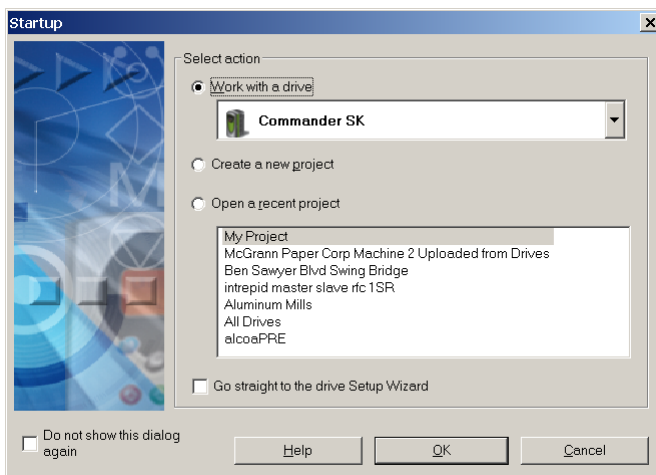
The use of CTSOft can make programming the SK Pump a simple task. Included with the SK Pump drive system, a dvd which not only contains the Commander SK Pump manual but also a parameter file which can be used to reset the drive back to default SK Pump parameters (Master SK Pump File with IO_descriptions.par). This file can be used to download to any size drive and also contains enhanced descriptions of SK Pump parameters.

The screenshot shows the CTSoft software interface. The title bar reads 'CTSoft - My Project - [My Drive - Menu 2 - Ramps (Offline)]'. The menu bar includes 'File', 'Edit', 'Drive', 'Monitoring', 'View', 'Window', and 'Help'. Below the menu bar is a toolbar with various icons. On the left, there is an 'Explorer' pane showing a tree view of the project structure, with 'Menu 2: Ramps' selected. Below the Explorer is a 'Toolbox' with 'Upload parameters' and 'Download parameters' buttons. The main area is a table of parameters.

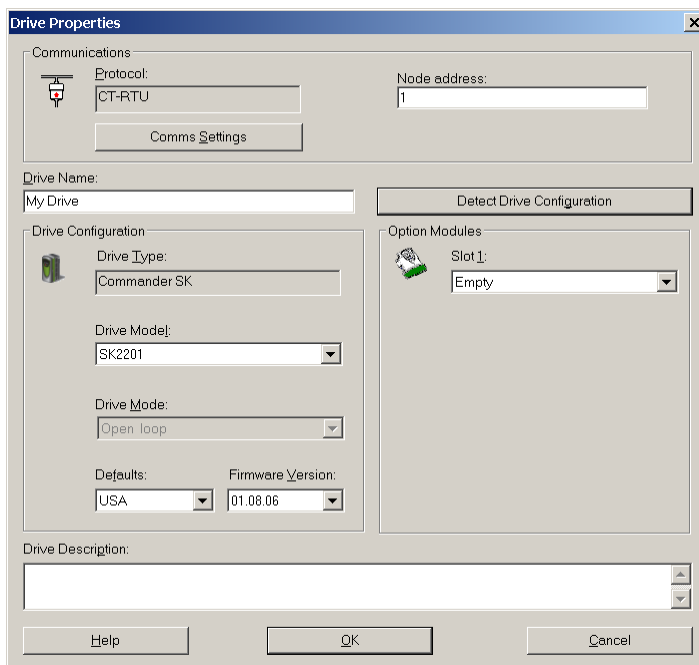
Parame...	Description	Default	Memory	Units
02.00	Parameter 0	0	0	
02.01	Post ramp reference	0.0	0.0	Hz
02.03	Ramp hold	OFF	OFF	
02.04	Ramp mode select	Std	Std/HV	
02.06	S ramp enable	OFF	On	
02.07	S ramp acceleration limit	3.1	3.1	s ² /100Hz
02.08	Standard ramp voltage	375	775	V
02.10	Acceleration rate selector	0	0	
02.11	Acceleration rate 1	33.0	1.0	s/100 Hz
02.12	Acceleration rate 2	5.0	5.0	s/100 Hz
02.13	Start Delay Time	5.0	5.0	s/100 Hz
02.14	Stop Delay Time	5.0	5.0	s/100 Hz
02.15	Pipe Fill Time	5.0	0.0	s/100 Hz
02.16	Under Pressure Detect Time	5.0	0.0	s/100 Hz
02.17	Sleep Start Time	5.0	15	s/100 Hz
02.18	Stabilize Delay Time	5.0	2.0	s/100 Hz
02.19	Jog acceleration rate	0.2	0.2	s/100 Hz
02.20	Deceleration rate selector	0	0	
02.21	Deceleration rate 1	33.0	1.0	s/100 Hz
02.22	Deceleration rate 2	10.0	10.0	s/100 Hz
02.23	Constant Freq Time	10.0	5.0	s/100 Hz
02.24	Dry Well Detection Time	10.0	0.0	s/100 Hz
02.25	Deceleration rate 5	10.0	10.0	s/100 Hz
02.26	Speed / Torque Low Load Point	10.0	0.0	s/100 Hz
02.27	Frequency Decrement Low Sucti...	10.0	0.0	s/100 Hz
02.28	Deceleration rate B	10.0	10.0	s/100 Hz
02.29	Jog deceleration rate	0.2	0.2	s/100 Hz
02.30	Acceleration selected indicator	0	1	
02.31	Deceleration selected indicator	0	1	
02.32	Acceleration select bit 0	OFF	OFF	
02.33	Acceleration select bit 1	OFF	OFF	
02.34	Acceleration select bit 2	OFF	OFF	
02.35	Deceleration select bit 0	OFF	OFF	
02.36	Deceleration select bit 1	OFF	OFF	
02.37	Deceleration select bit 2	OFF	OFF	
02.39	Ramp rate units	s/100 Hz	s/100 ...	

The procedure to restore parameters will be demonstrated in the following pages.

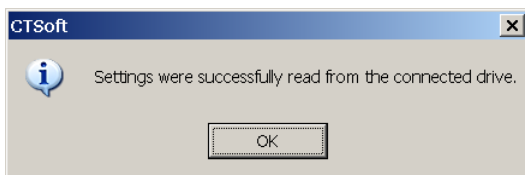
8.2.1 Open CTSOft



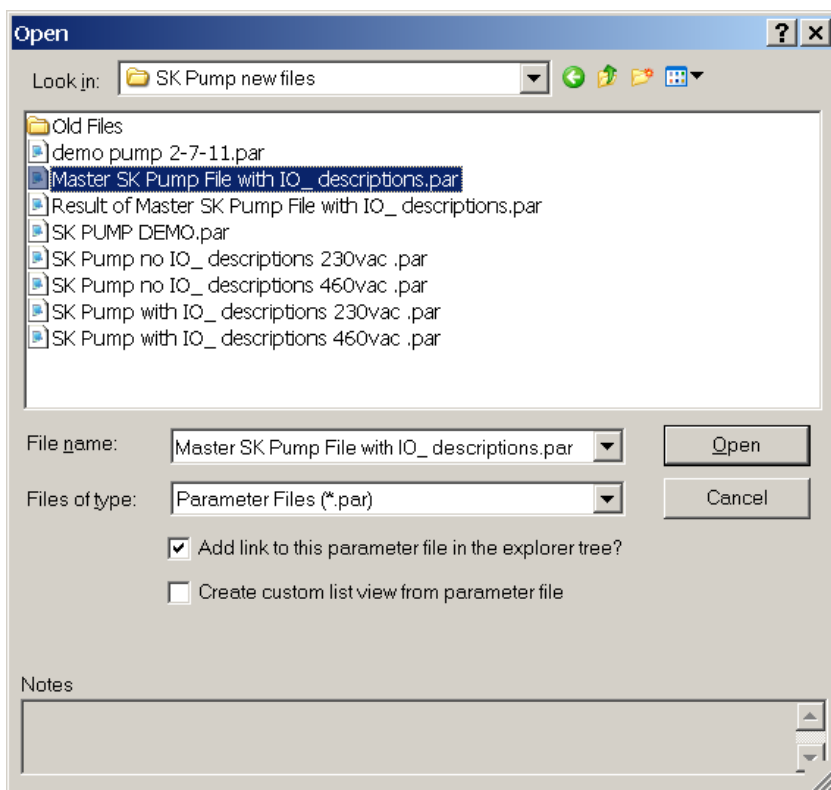
Select Work with a drive option button and then select the Commander SK



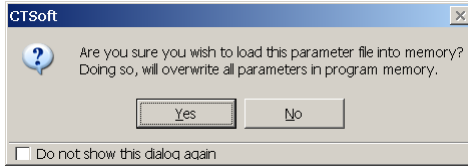
Select Detect Drive Configuration



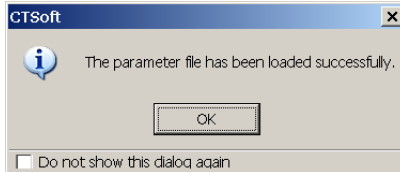
If your communications are good the screen above should appear, click OK.



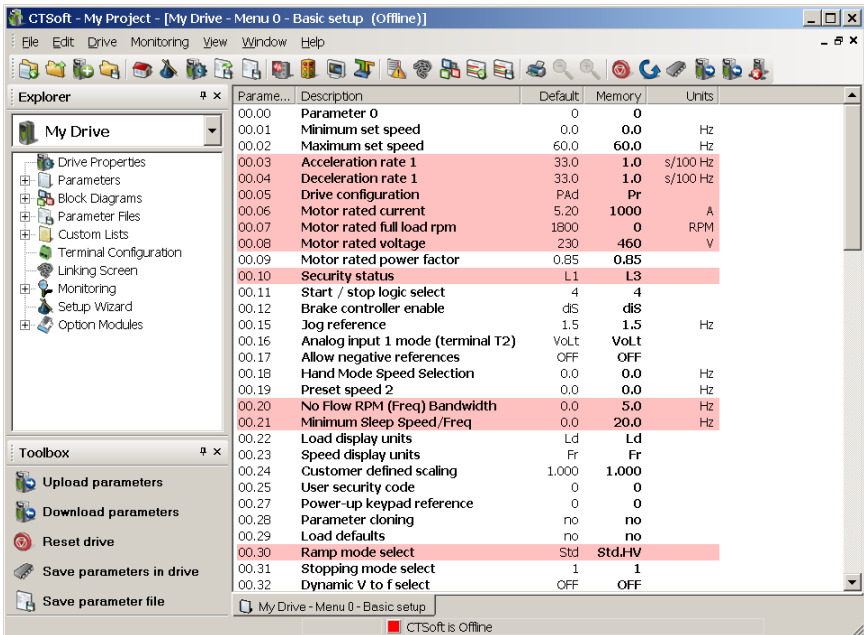
Under the File drop down menu, select the Master SK Pump file on the CD-ROM and click open. This file is also available on our web site if you do not have the CD-ROM or to check for an updated version.



When this screen appears, select Yes only if you have the SK Pump drive with the optional SM-I/O Lite module installed otherwise select No.



CTSoft loads the parameter file into the program and then click OK.



CTSoft screen

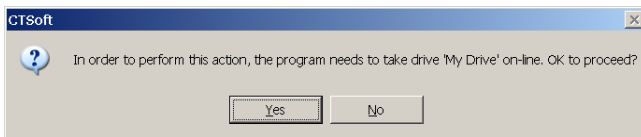
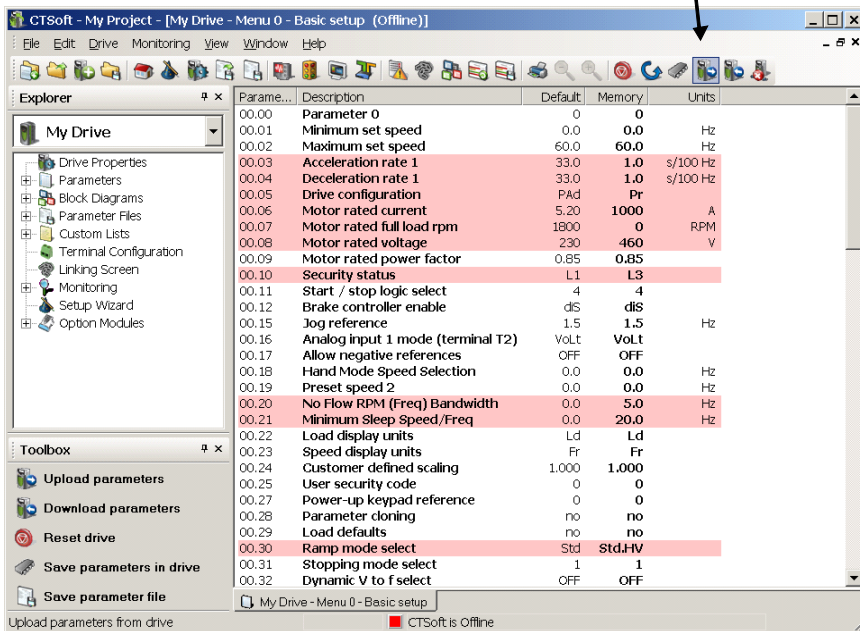
The parameters shown above in red are not drives standard default.

The differences from the drives standard defaults are shown in red. The descriptions are also different from the files default descriptions to match the Pump functions for the program.

NOTE

At this point, up load the parameters from the drive, this action will correct the file in CTSOft to match the actual drive (since the Generic file on the CD-ROM does not contain the drive voltage and current rating).

Click the upload in the Icon Bar at the top



Click Yes, CTSOft will go online, upload the parameters, then go off line.

Once the upload is complete, save the parameter file using "save parameter file..." in the File menu giving it a unique name.

Now click on the red square at the bottom of the CTSOft screen to go online with the drive.

The SK Pump drive system can now be customized for the pump requirements (starting at page 22 - after entering in the pump motor current rating). Don't forget to save your file when you are done.

9 Function Block Diagrams

The block diagrams on the next several pages represent the logical operation of the SK Pumping program. The pages are separated in functional categories and each is numbered in the upper left corner. Often there are references to these page numbers from other blocks in the chart and indicated by a bordered number in the lower left corner.

- Diagram 0 Main Pumping Macro on page 46
- Diagram 1 Pump Mode 1, 18.12=1 on page 47
- Diagram 2 Pump Mode 2, 18.12=2 on page 48
- Diagram 3 Pump Mode 3, 18.12=3 on page 49
- Diagram 4 Pump System Set-Point on page 50
- Diagram 5 Pipe Fill Time on page 51
- Diagram 6 AUTO Reset Function on page 52
- Diagram 7 Pump Faults on page 53
- Diagram 8 Pump Alarms on page 55
- Diagram 9 No Flow Detection and Sleep on page 56
- Diagram 10 Digital Output on page 57
- Diagram 11 Digital Inputs on page 58
- Diagram 12 Dry Well/Low Suction Detection on page 59
- Diagram 13 Under Pressure Detection on page 60
- Diagram 14 Pressure Transducer Scaling on page 61
- Diagram 15 Overview - Menu 0 on page 62

0

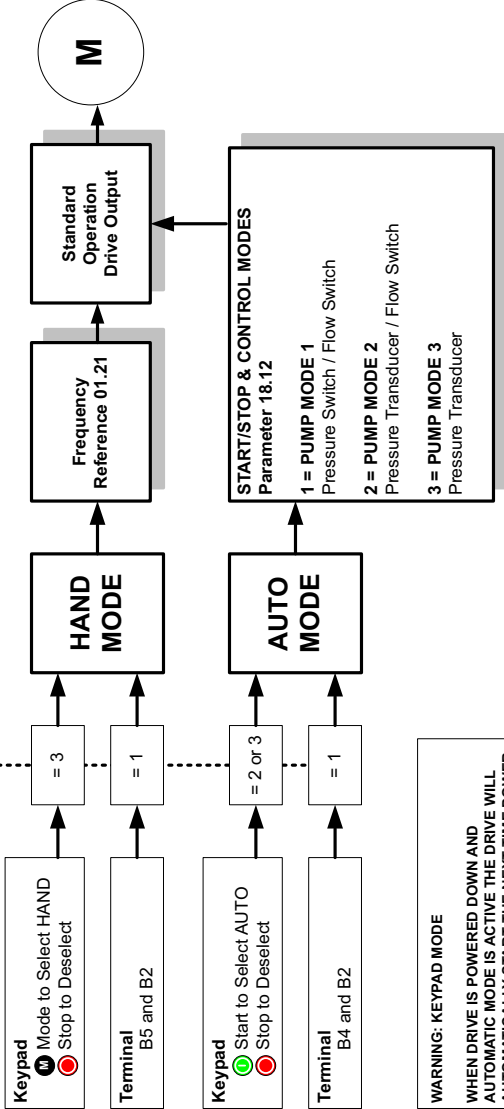
MAIN PUMPING MACRO

VER 06.00.01

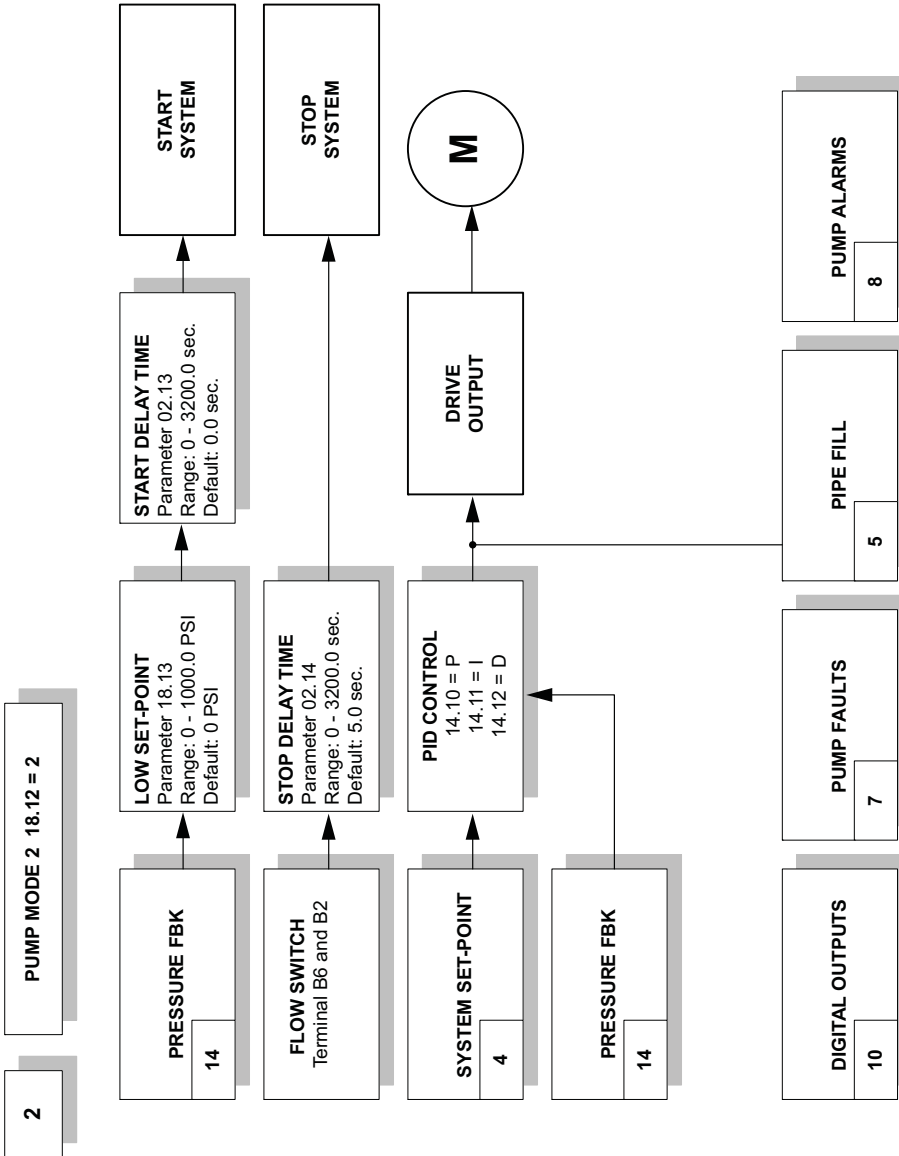
Parameter 18.28 = Software Rev.

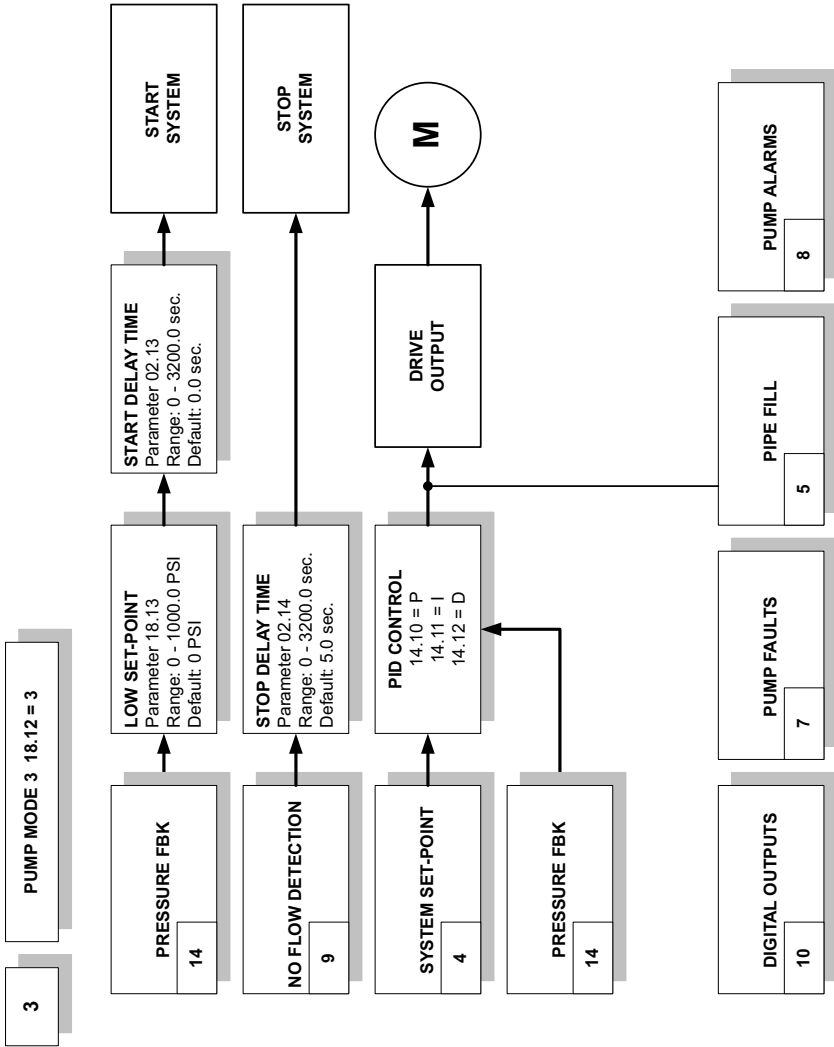
OPERATION MODE
 Parameter 18.11
 0 = Off
 1 = Terminals
 2 = Keypad (AUTO Only)
 3 = Keypad (AUTO + HAND)
 Default: 1

The Commander SK will be inhibited 'inh' when
 Hand AND Auto are NOT selected.



WARNING: KEYPAD MODE
 WHEN DRIVE IS POWERED DOWN AND
 AUTOMATIC MODE IS ACTIVE THE DRIVE WILL
 AUTOMATICALLY START THE NEXT TIME POWER
 IS APPLIED TO THE SYSTEM.





4

PUMP SYSTEM SET-POINT

TERMINAL
T5 & T6 Open
(SM-I/O Lite)

MAIN SET_POINT
Parameter 18.30
Range: 0 - 1000.0 PSI
Default: 0 PSI

TERMINAL
T5 Closed & T6 Open
(SM-I/O Lite)

SET_POINT 1
Parameter 18.24
Range: 0 - 1000.0 PSI
Default: 0 PSI

TERMINAL
T5 Open & T6 Closed
(SM-I/O Lite)

SET_POINT 2
Parameter 18.25
Range: 0 - 1000.0 PSI
Default: 0 PSI

TERMINAL
T5 Closed & T6 Closed
(SM-I/O Lite)

SET_POINT 3
Parameter 18.26
Range: 0 - 1000.0 PSI
Default: 0 PSI

**SYSTEM
SET-POINT
SELECTION**

SYSTEM SET-POINT
Parameter 18.04
Range: 0-1000.0 PSI.

DIGITAL INPUTS

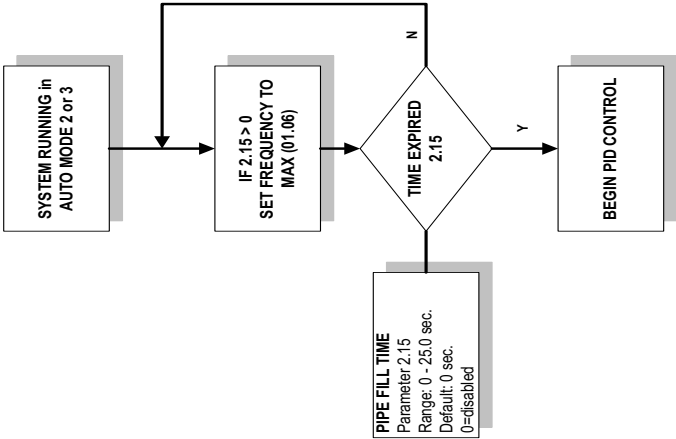
11

TRUTH TABLE

T6	T5	TERMINAL
18.37	18.36	PARAMETER
OPEN	OPEN	MAIN SET-POINT
OPEN	CLOSED	SET-POINT 2
CLOSED	OPEN	SET-POINT 3
CLOSED	CLOSED	SET-POINT 4

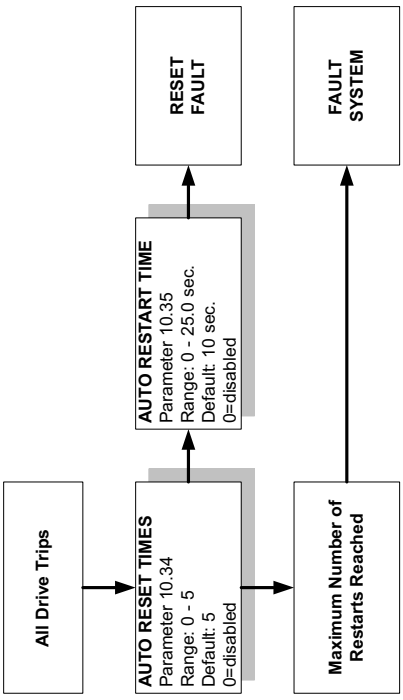
5

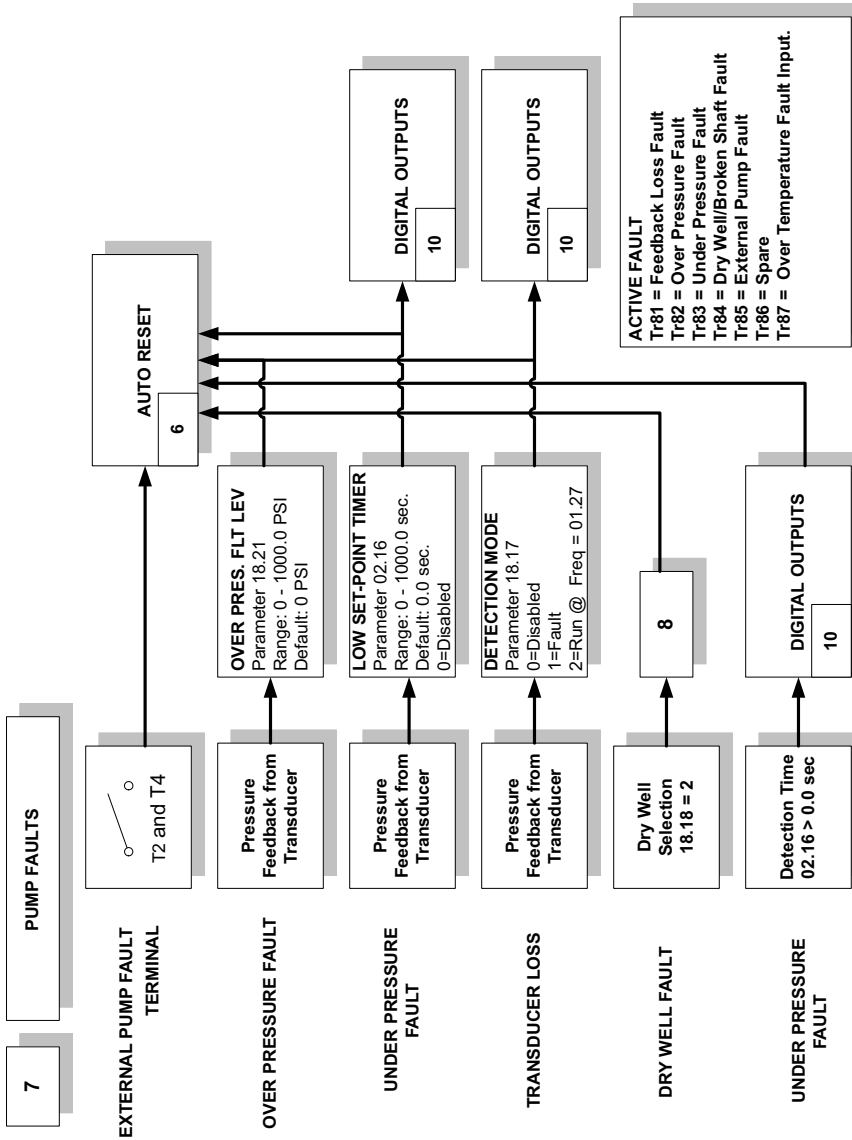
PIPE FILL TIME



6

AUTO RESET FUNCTION

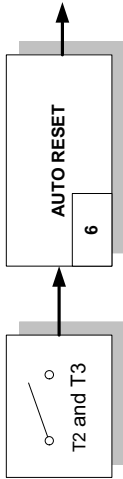




7

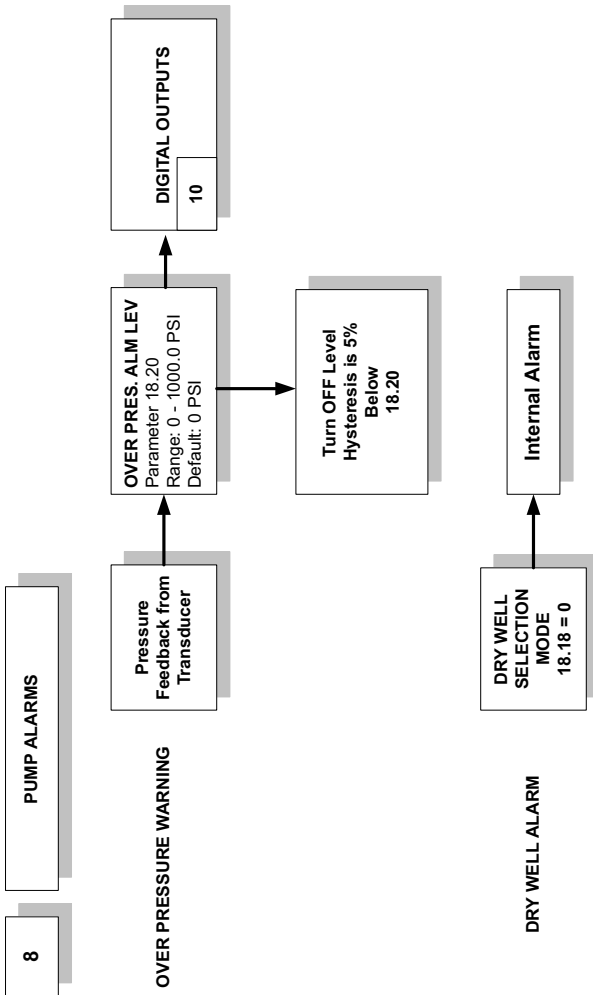
PUMP FAULTS

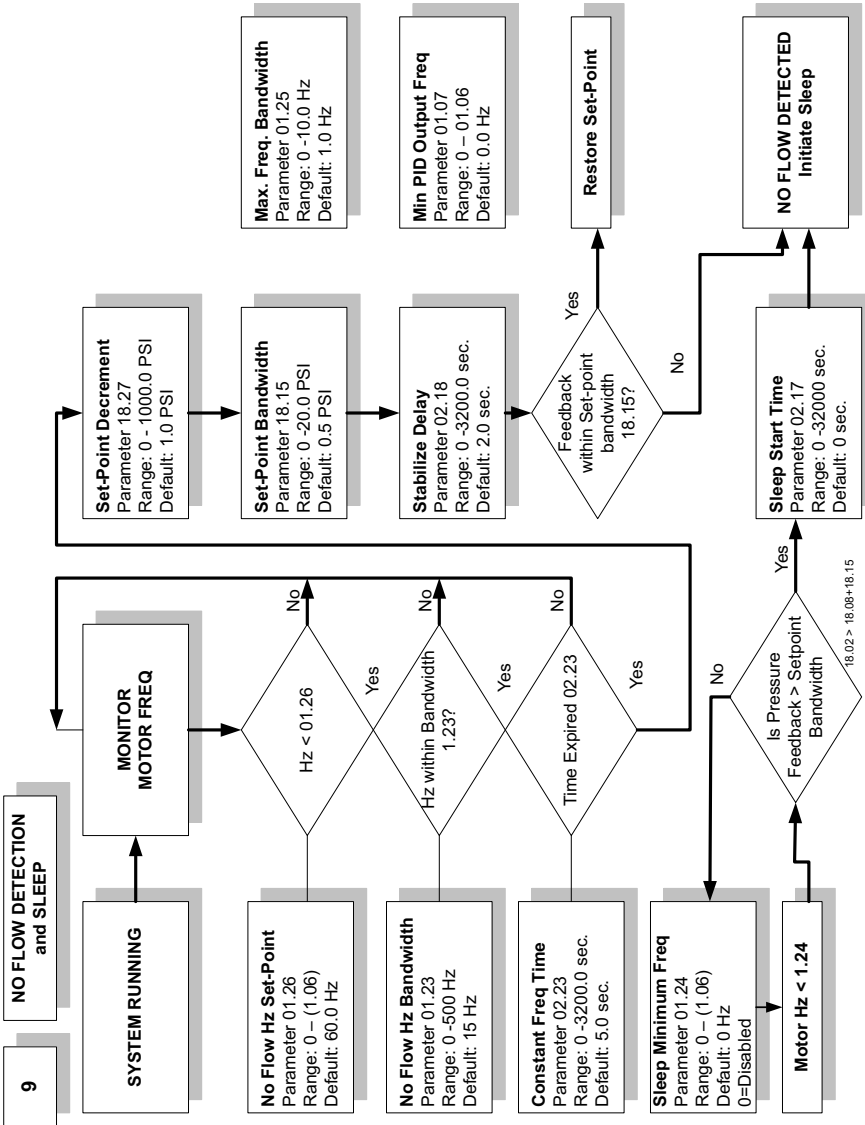
OVER TEMPERATURE
TERMINAL

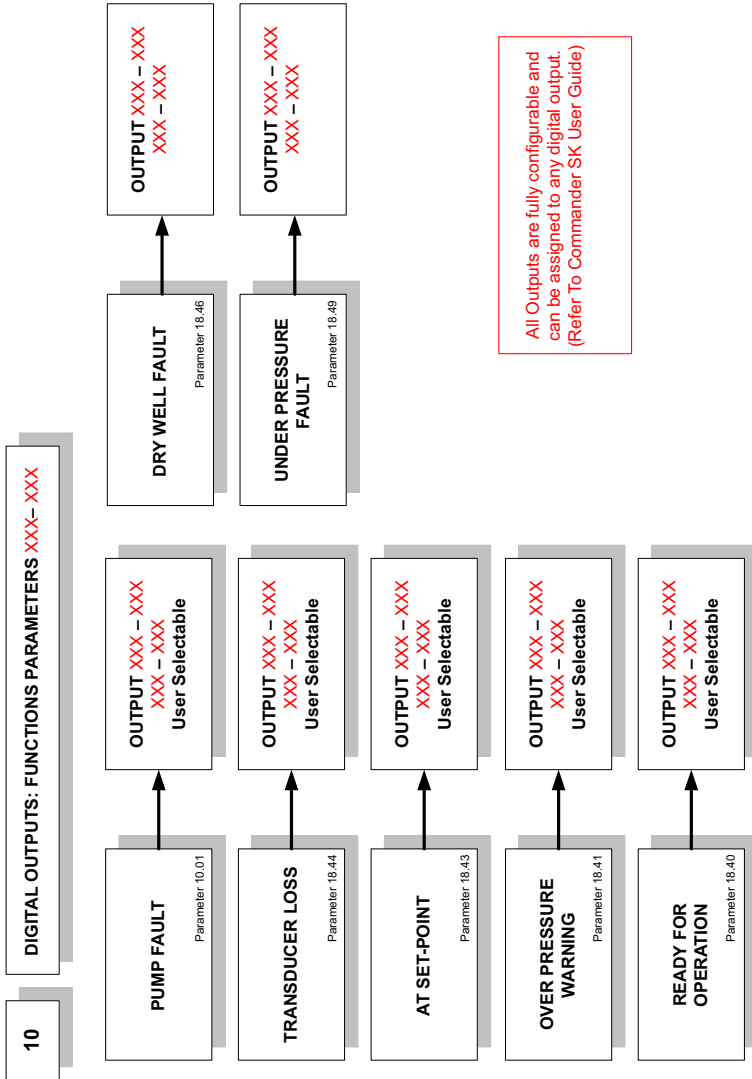


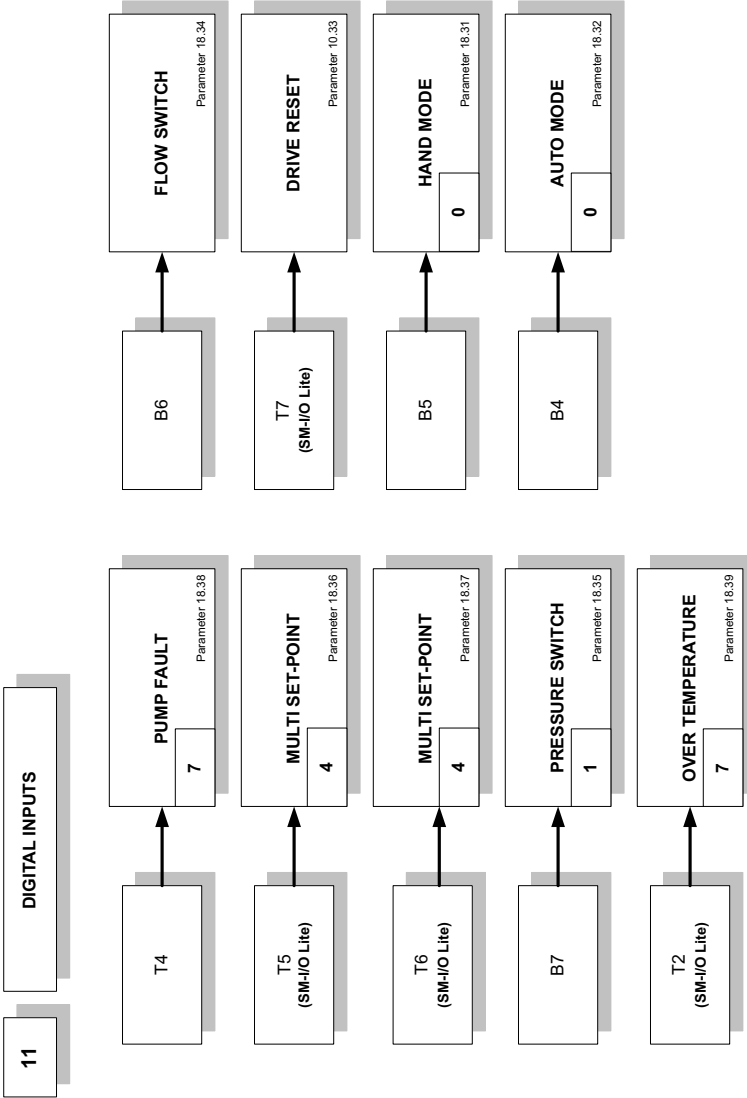
ACTIVE FAULT

- Tr81 = Feedback Loss Fault
- Tr82 = Over Pressure Fault
- Tr83 = Under Pressure Fault
- Tr84 = Dry Well/Broken Shaft Fault
- Tr85 = External Pump Fault
- Tr86 = Spare
- Tr87 = Over Temperature Fault Input.









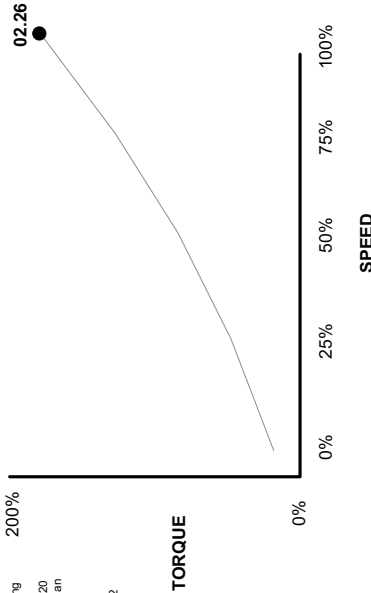
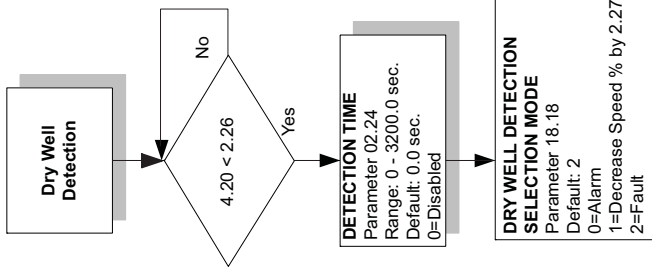
12

DRY WELL / LOW SUCTION DETECTION

NOTE:

This function detects a low load on the motor when running at maximum speed indicating a dry or unloaded pump. To set:
 1. Run fully loaded pump at maximum speed and record average value in parameter 4.20
 2. Set parameter 2.26 to a value lower than the recorded value in 4.20 and higher than an unloaded pump.

- Dry well/ Low Suction has a higher priority than flow/no-flow detection
- Dry well/ Low Suction has a higher priority than feedback loss @ fixed speed 18.17=2



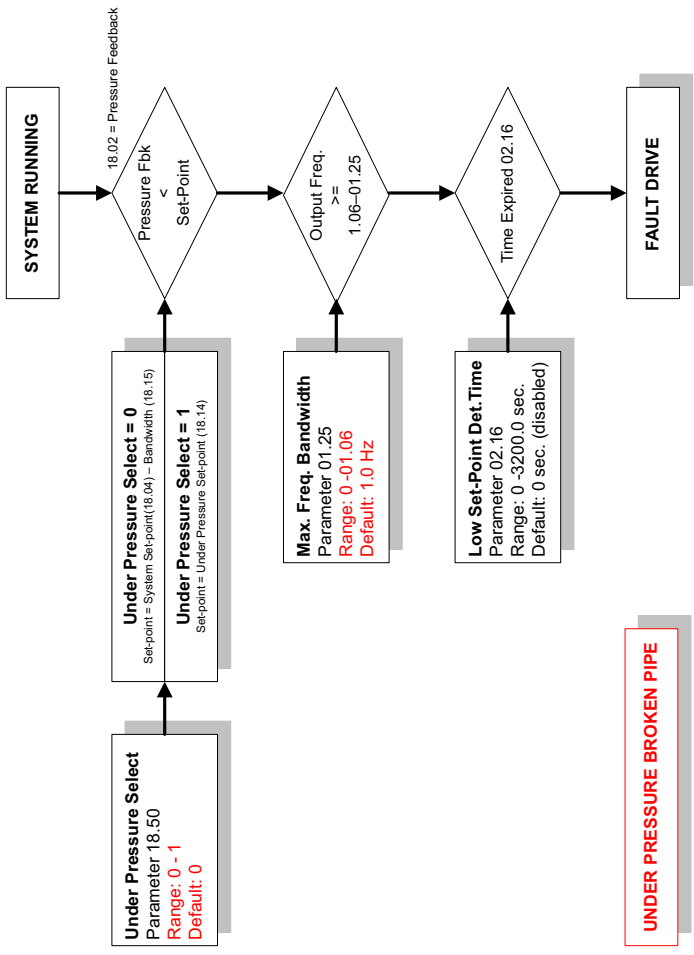
Set-Point Decrement
 Parameter 02.27
 Range: 0 - 10.0 %
 Default: 1.0 %

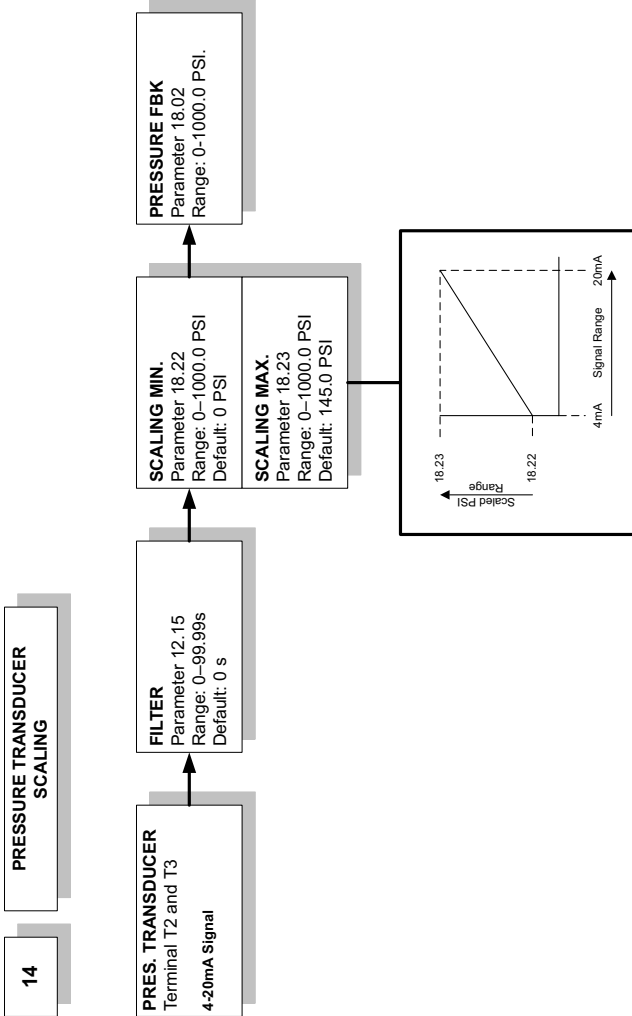
Motor Load Percentage
 Parameter 04.20
 Range: 0 - 200%
 Read Only

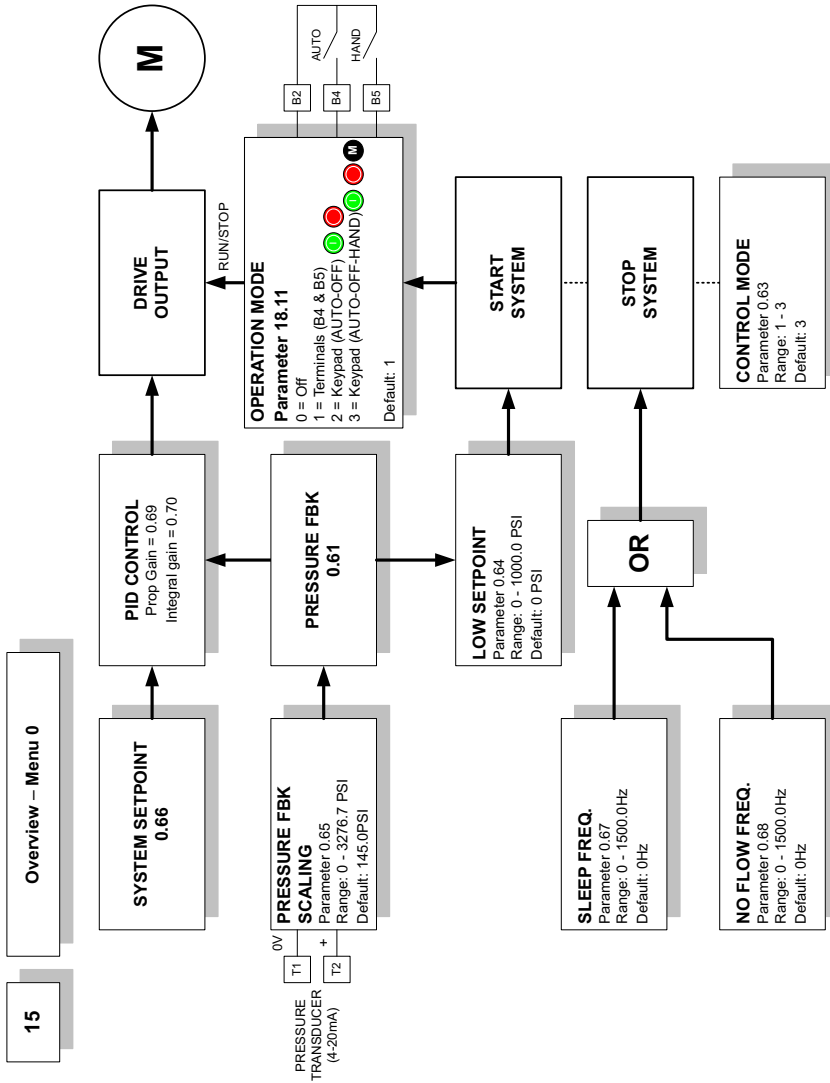
Low Load Point
 Parameter 02.26
 Range: 0 - 200%
 Default: 0%.

13

UNDER PRESSURE DETECTION







10 Parameter Descriptions

10.1 Pump Specific Parameter Descriptions

Many of the Commander SK parameters have different functionality than standard when used in the Pump Solution mode. If not listed in the table below the functionality is standard as listed in the *Commander SK Getting Started Guide* and *Commander SK Advanced User Guide*.

10.1.1 Keypad Parameters

Pr	Description	Type	Units	Range	Default
01	Minimum Set Speed	RW	Hz	0-1500	0
02	Maximum Set Speed	RW	Hz	0-1500	60
03	Acceleration Rate	RW	s/100Hz	0-3200	1.0
04	Deceleration Rate	RW	s/100Hz	0-3200	1.0
05	Drive Configuration	RW	-	-	Pr (Preset)
06	Motor Rated Current	RW	Amps	-	0
07	Motor Rated RPM	RW	RPM	0-9999	0
08	Motor Rated Voltage	RW	Volts	-	-
09	Motor Power Factor	RW	-	0-1.00	0.85
10	Security Status	RW	-	-	L3
11	Start/Stop Logic Select	RW		0-6	0
16	Analog 1 Input Mode	RW	-	-	4
18	HAND Mode Speed	RW	Hz	+/-1500.0	0
20	No Flow RPM (Freq) Bandwidth	RW	Hz	+/-1500.0	15
21	Minimum Sleep Speed/Freq	RW	Hz	+/-1500.0	0
41	Voltage Mode Select	RW	-	-	FD (Fixed)
59	PLC Ladder Program Enable	RW	-	-	Run/Clip
60	PLC Ladder Program Status	RO	-	-	V
61	Pressure Feedback (Pr 18.02)	RO	0.1 PSI	+/-32767	-
62	Pumping Macro (Pr 18.11)	RW	-	+/-32767	0 (Off)
63	Start/Stop Control Modes (Pr 18.12)	RW	-	+/-32767	3 (PT)
64	Low Pressure setpoint (Pr 18.13)	RW	0.1 PSI	+/-32767	0
65	Maximum Pressure Scaling (Pr 18.23)	RW	0.1 PSI	+/-32767	1450
66	Main Pressure setpoint (Pr 18.30)	RW	0.1 PSI	+/-32767	0
67	Minimum Sleep Frequency (Pr 1.24)	RW	Hz	+/-1500.0	0
68	No Flow Frequency (Pr 1.26)	RW	Hz	+/-1500.0	0
69	Proportional Gain (Pr 14.10)	RW	Gain	0-4.000	1
70	Integral Time (Pr 14.11)	RW	sec	0-4.000	0.5

Pr	Description	Type	Units	Range	Default
71	Pr 61 Set Up	RW	-	-	18.02
72	Pr 62 Set Up	RW	-	-	18.11
73	Pr 63 Set Up	RW	-	-	18.12
74	Pr 64 Set Up	RW	-	-	18.13
75	Pr 65 Set Up	RW	-	-	18.23
76	Pr 66 Set Up	RW	-	-	18.30
77	Pr 67 Set Up	RW	-	-	1.24
78	Pr 68 Set Up	RW	-	-	1.26
79	Pr 69 Set Up	RW	-	-	14.10
80	Pr 70 Set Up	RW	-	-	14.11
94	Analog 1 Input Level	RO	%	0-100.0	-

10.1.2 Advanced Parameters

Pr	Description	Type	Units	Range	Default
1.21	HAND Mode Speed Selection	RW	Hz	+/-1500.0	0
1.23	No Flow RPM (Freq) Bandwidth	RW	Hz	+/-1500.0	15
1.24	Minimum Sleep Speed/Freq	RW	Hz	+/-1500.0	0
1.25	Max. Frequency Bandwidth	RW	Hz	+/-1500.0	1
1.26	No Flow RPM (Freq) setpoint	RW	Hz	+/-1500.0	0
1.27	Transducer Loss Frequency	RW	Hz	+/-1500.0	0
1.28	For Program Use	RO	-	-	-
2.13	Start Delay Time	RW	sec	0-3200.0	0
2.14	Stop Delay Time	RW	sec	0-3200.0	5
2.15	Pipe Fill Time	RW	sec	0-3200.0	0
2.16	Under Pressure Detect Time	RW	sec	0-3200.0	0
2.17	Sleep Start Time	RW	sec	0-3200.0	0
2.18	Stabilize Delay	RW	sec	0-3200.0	2
2.23	Constant Freq. Time	RW	sec	0-3200.0	5
2.24	Dry Well Detection Time	RW	sec	0-3200.0	0
2.26	Speed/Torque Low Load Point	RW	0.10%	0-3200.0	0
2.27	Frequency Decrement Low Suction	RW	0.10%	0-3200.0	0
5.07	Motor Rated Current	RW	Amps	-	0
5.08	Motor Rated RPM	RW	RPM	-	0
5.09	Motor Rated Voltage	RW	Volts	-	
5.10	Motor Power Factor	RW	-	0-1.00	0.85
5.14	Voltage Mode Select	RW	-	-	FD (Fixed)
7.06	Analog 1 Input Mode	RW	-	-	2
7.10	Analog Input 1 Destination	RW	-	-	0
7.11	Analog Input 2 Mode	RW	-	-	dig
7.14	Analog Input 2 Destination	RW	-	-	0
8.22	Terminal B4 Destination	RW	-	-	18.31
8.23	Terminal B5 Destination	RW	-	-	18.32
8.24	Terminal B6 Destination	RW	-	-	18.34
8.25	Terminal B7 Destination	RW	-	-	18.35
10.01	System Fault Status	RO		0-1	
10.20	Last Trip	RO	-	-	-
10.34	Auto Reset Times	RW	-	0-5	5
10.35	Auto Restart Time	RW	sec	0-25.0	10

Pr	Description	Type	Units	Range	Default
11.27	Drive Configuration	RW	-	-	Pr (Preset)
11.44	Security Status	RW	-	-	L3
11.47	PLC Ladder Program Enable	RW	-	-	Run/Clip
12.03	Threshold Detector 1 Source	RW	-	-	15.40
12.04	Threshold Detector 1 Level	RW	%	0-100.0	10
12.07	Threshold Detector 1 Destination	RW	-	-	18.39
12.08	Variable Selector 1 Source 1	RW	-	-	7.01
12.10	Variable Selector 1 Mode	RW	-	-	6
12.15	Pressure Transducer Filter	RW	sec	0-99.99	0
14.02	PID Main Reference Source	RW	-	-	18.29
14.03	PID Reference Source	RW	-	-	18.05
14.04	PID Feedback Source	RW	-	-	12.12
14.10	Proportional Gain	RW	Gain	0-4.000	1
14.11	Integral Time	RW	sec	0-4.000	0.5
14.12	Differential Rate	RW	d/dt	0-4.000	0
14.14	PID Lower Limit	RW	%	+/-100.0	0
14.16	PID Output Destination	RW	-	-	1.36
15.24	Terminal T5 Destination	RW	-	-	-
15.25	Terminal T6 Destination	RW	-	-	-
15.26	Terminal T7 Destination	RW	-	-	-
15.27	Terminal T21/T23 Relay Source	RW	-	-	-
15.38	Analog Input T2 mode	RW		-	Volt
18.01	For Program Use (NV)	RO	-	+/-32767	-
18.02	Pressure Feedback Value	RO	0.1 PSI	+/-32767	-
18.03	PID Error	RO	0.1 PSI	+/-32767	-
18.04	Selected Setpoint Value	RO	0.1 PSI	+/-32767	-
18.05	Scaled Setpoint for PID	RO	P.U.	+/-32767	-
18.06	For Program Use	RO	-	+/-32767	-
18.07	For Program Use	RO	-	+/-32767	-
18.08	Final Setpoint with Inc & Dec	RO	0.1 PSI	+/-32767	-
18.09	For Program Use	RO	-	+/-32767	-
18.10	For Program Use	RO	-	+/-32767	-
18.11	Pumping Macro Select	RW	-	+/-32767	0 (Off)
18.12	Start/Stop & Control Modes	RW	-	+/-32767	3 (PT)
18.13	Low Setpoint	RW	0.1 PSI	+/-32767	0
18.14	Under Pressure Setpoint	RW	0.1 PSI	+/-32767	0
18.15	Setpoint Bandwidth	RW	0.1 PSI	+/-32767	5

Pr	Description	Type	Units	Range	Default
18.17	Transducer Loss Action	RW	-	+/-32767	1 (Trip)
18.18	Dry Well Selection Mode	RW	-	+/-32767	2 (Trip)
18.20	Over Pressure Alarm Level	RW	0.1 PSI	+/-32767	0
18.21	Over Pressure Fault Level	RW	0.1 PSI	+/-32767	0
18.22	Minimum Feedback Scaling	RW	0.1 PSI	+/-32767	0
18.23	Maximum Feedback Scaling	RW	0.1 PSI	+/-32767	1450
18.24	Alternate Set-point 1	RW	0.1 PSI	+/-32767	0
18.25	Alternate Set-point 2	RW	0.1 PSI	+/-32767	0
18.26	Alternate Set-point 3	RW	0.1 PSI	+/-32767	0
18.27	Set-point Decrement	RW	0.1 PSI	+/-32767	10
18.28	Software Version	RO	-	+/-32767	-
18.29	PID Saturate	RO	-	+/-32767	-
18.30	Main Set-point	RW	0.1 PSI	+/-32767	0
18.31	AUTO Mode Select Input	RO	-	0-1	0
18.32	HAND Mode Select Input	RO	-	0-1	0
18.33	Pipe Fill Time Done	RO	-	0-1	0
18.34	Flow Switch Input	RO	-	0-1	0
18.35	Pressure Switch Input	RO	-	0-1	0
18.36	Multi-set p1 Input	RO	-	0-1	0
18.37	Multi-set p2 Input	RO	-	0-1	0
18.38	Pump Fault Input	RO	-	0-1	0
18.39	Over Temperature Input	RO	-	0-1	1
18.40	System Ready Status	RO	-	0-1	0
18.41	Overpressure Warning Status	RO	-	0-1	0
18.42	Within Max Freq. Bandwidth Status	RO	-	0-1	0
18.43	AT Reference Digital Status	RO	-	0-1	0
18.44	Transducer Loss Digital Output	RO	-	0-1	0
18.45	Drive Running In AUTO	RO	-	0-1	0
18.46	Dry Well/Low Suction Status	RO	-	0-1	0
18.47	AUTO Mode Selected Status	RO	-	0-1	0
18.48	HAND Mode Selected Status	RO	-	0-1	0
18.49	Spare	-	-	0-1	0
18.50	Under Pressure Select Setpoint	RW	-	0-1	0
21.08	Reserved for program use	RO	-	-	-

RW = Read/Write Parameter

RO = Read Only Parameter

10.1.3 Other Documentation References

Manual Description	CT Part Number
Commander SK Getting Started Guide	0472-0000-XX
Commander SK Advanced User Guide	0447-0002-XX

10.1.4 Keypad Parameters

Pr	Function	Range	Units	Default	Type
01	Minimum Set Speed	0 - 1500	Hz	0	RW

Sets the minimum frequency that the drive will run at when a run command is issued. Setting Pr02 to a lower value will override this setting.

Pr	Function	Range	Units	Default	Type
02	Maximum Set Speed	0 - 1500.0	Hz	60.0	RW

This is the maximum frequency that the drive will run at regardless if the setpoint frequency is set higher

Pr	Function	Range	Units	Default	Type
03	Acceleration Rate	0 - 3200.0	s/100 Hz	1	RW


Defines the acceleration rate of the motor in seconds per 100 Hz. Too high of a setting will result in a slow responding PID loop and may cause other time sensitive diagnostic routines issues.

Pr	Function	Range	Units	Default	Type
04	Deceleration Rate	0 - 3200.0	s/100 Hz	1	RW

Defines the deceleration rate of the motor in seconds per 100Hz. Too high of a setting will result in a slow responding PID loop and may cause other time sensitive diagnostic routines issues.

Pr	Function	Range	Units	Default	Type
05	Drive Configuration			Pr	RW

Sets the drive configuration mode i.e. the reference source location for the drive and I/O configuration. Always set this to Preset (Pr).

	<p>If this parameter is changed many other parameters will automatically change as a result. Therefore, set this to Pr and perform a drive reset prior to setting any other parameters.</p>
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Pr	Function	Range	Units	Default	Type
06	Motor Rated Current	0 to Drive Rated Current	Amps	0	RW

Defines the full load Amps of the motor rating. Enter the motor nameplate value in Amps.

Pr	Function	Range	Units	Default	Type
07	Motor Rated RPM	0-9999	RPM	0	RW

Set to zero the disable slip compensation.

Pr	Function	Range	Units	Default	Type
08	Motor Rated Voltage	0 -240 V, 0 - 480 V, 0 - 575 V, 0 - 690 V	Volts	230, 460, 575, 690 depending on drive model	RW

Enter the rated motor voltage at base speed.

Pr	Function	Range	Units	Default	Type
09	Motor Power Factor	0 -1		0.85	RW

Enter the motor power factor. If unknown leave at default or perform a rotating auto-tune.

Pr	Function	Range	Units	Default	Type
10	Security Status	L1, L2, L3, LoC		L3	RW

This setting defines the level of security for menu 0 through the keypad.

Value	Level	Access Permitted
0	L1	Only the first ten parameters can be accessed
1	L2	Parameters up to 60 can be accessed
2	L3	Parameters up to 95 can be accessed
3	LoC	Lock security, so that the security code must be entered before a parameter can be edited and set security status to L1

Pr	Function	Range	Units	Default	Type
16	Analog 1 Input Mode, Pressure Transducer	0 - 6		4	RW

Defines the type of analog signal that is connected to terminal 2.

Value	Display	Function
0	0-20	0 mA to 20 mA
1	20-0	20 mA to 0 mA
2	4-20	4 mA to 20 mA with trip on loss
3	20-4	20 mA to 4 mA with trip on loss
4	4-.20	4 mA to 20 mA with no trip on loss
5	20-.4	20 mA to 4 mA with no trip on loss
6	VoLt	0 V to +10 Volts

Pr	Function	Range	Units	Default	Type
18	HAND Mode Speed Setting	0 - Maximum speed set in Pr 02	Hz	0	RW

Sets the type of analog signal that is connected to terminal 2.

Pr	Function	Range	Units	Default	Type
20	No Flow RPM (Freq) Bandwidth	0 - 1500.0	Hz	15	RW

The Hz bandwidth setting used in No Flow Detection. The system monitors the motor frequency and if it is below the setting in 1.26 (68) +/- this bandwidth setting for the period of time set in Pr 2.23 the system proceeds with the No Flow Detection process.

Pr	Function	Range	Units	Default	Type
21	Minimum Sleep Speed/Freq	0 - 1500.0	Hz	0	RW

While running in PID, if the motor frequency falls below this level for the period of time set in Pr 2.17 and the pressure feedback is higher than the setpoint with bandwidth, the system will initiate sleep.

Pr	Function	Range	Units	Default	Type
41	Voltage Mode Select			FD	RW

Selects the type of voltage control used. Normally FD (fixed V/Hz with low speed boost) is used. Further details are provided in the *Commander SK User Guide*.

Pr	Function	Range	Units	Default	Type
59	PLC Ladder Program Enable			Run/Clip	RW

Defines how the Pump program will execute. Always set to Run with Clip.

Pr	Function	Range	Units	Default	Type
60	PLC Ladder Program Status				RO

Indicates the status of the Pump program execution. Under normal running conditions a 2 is displayed.

Value	Description
-n	PLC ladder program caused a drive trip due to an error condition while running rung n. Note that the rung number is shown on the display as a negative number
0	LogicStick is installed with no PLC ladder program
1	LogicStick is installed, PLC ladder program is installed but stopped
2	LogicStick is installed, PLC ladder program is installed and running
3	LogicStick is not installed

Pr	Function	Range	Units	Default	Type
61	Pressure Feedback Value	± 32767	0.1 PSI		RO

Indicates the scaled pressure feedback PSI

Pr	Function	Range	Units	Default	Type
62	Pumping Macro Select	± 32767		0	RW

Defines the Operation Mode of the Pump system.

0 = Off

1 = Terminals

2 = Keypad, Automatic Only

3 = Keypad, Automatic and Hand.

Pr	Function	Range	Units	Default	Type
63	Start/Stop & Control Mode	± 32767		3	RW

This parameter sets the Start/Stop modes of the drive.

1 = Pressure Switch/Flow Switch. The drive will start when the feedback pressure switch closes and runs until a stop command is given or a no flow detection is made from the No Flow switch input.

2 = Pressure Transducer/Flow Switch. The drive will start when the feedback pressure transducer level is below the Low Setpoint (Pr 18.13), and runs until a stop command is given or a no flow detection is made from the No Flow switch input.

3 = Pressure Transducer. The drive will start when the feedback pressure transducer level is below the Low Setpoint (Pr 18.13), and runs until a stop command is given or a No Flow detection is made (see No Flow diagram for details).

Pr	Function	Range	Units	Default	Type
64	Low Setpoint	± 32767	0.1 PSI		RW

Set this parameter to the pressure at which the drive will begin to run in Modes 2 and 3 (set by Pr 63 (Pr18.12).

Pr	Function	Range	Units	Default	Type
65	Maximum Feedback Scaling	± 32767	0.1 PSI	1450	RW

Sets the scaling in PSI for the maximum pressure reading of the feedback transducer

Pr	Function	Range	Units	Default	Type
66	Proportional Gain	0 - 4.000	Gain	1	RW

The main pressure setpoint for the system to maintain, entered in PSI.

Pr	Function	Range	Units	Default	Type
67	Minimum Sleep Speed/Freq	0 - 1500.0	Hz	0	RW

While running in PID, if the motor frequency falls below this level for the period of time set in Pr 2.17 and the pressure feedback is higher than the setpoint with bandwidth, the system will initiate sleep.

Pr	Function	Range	Units	Default	Type
68	No Flow RPM (Freq) Setpoint	0 - 1500.0	Hz	0	RW

In No Flow Detection, the system monitors the motor frequency and if it is below the setting in Pr 68 (Pr 1.26) +/- the bandwidth in Pr 1.23 for the period of time set in Pr 2.23 the system proceeds with the No Flow Detection process.

Pr	Function	Range	Units	Default	Type
69	Proportional Gain	0 - 4.000	Gain	1	RW

Maps the pressure feedback signal to the PID loop. Always set to Pr 12.12.

Pr	Function	Range	Units	Default	Type
70	Integral Time	0 - 4.000	sec	0.5	RW

The PID loop Integral time setting.

Pr	Function	Range	Units	Default	Type
71	Pr 61 Pointer			Pr 18.02	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr 61. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr 61 to Pr 70.

Pr	Function	Range	Units	Default	Type
72	Pr 62 Pointer			Pr 18.11	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr 62. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr 61 to Pr 70.

Pr	Function	Range	Units	Default	Type
73	Pr 63 Pointer			Pr 18.12	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr 63. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr 61 to Pr 70.

Pr	Function	Range	Units	Default	Type
74	Pr 64 Pointer			Pr 18.13	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr 64. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr 61 to Pr 70.

Pr	Function	Range	Units	Default	Type
75	Pr 65 Pointer			Pr 18.23	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr 65. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr 61 to Pr 70.

Pr	Function	Range	Units	Default	Type
76	Pr 66 Pointer			Pr 18.30	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr 66. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr 61 to Pr 70.

Pr	Function	Range	Units	Default	Type
77	Pr 67 Pointer			Pr 1.24	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr 67. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr 61 to Pr 70.

Pr	Function	Range	Units	Default	Type
78	Pr 68 Pointer			Pr 1.26	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr **68**. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr **61** to Pr **70**.

Pr	Function	Range	Units	Default	Type
79	Pr 69 Pointer			Pr 14.10	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr **69**. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr **61** to Pr **70**.

Pr	Function	Range	Units	Default	Type
80	Pr 70 Pointer			Pr 14.11	RW

Maps the drive parameter that will be accessible from the Commander SK keypad in Pr **70**. Only menu 0 parameters are accessible through the built in keypad. Therefore, to read and write to higher level parameters you may utilize the 10 "pointer" Pr **61** to Pr **70**.

Pr	Function	Range	Units	Default	Type
94	Analog 1 Input Level, Pressure Transducer Feedback	0 -100	%		RO

The level of the pressure transducer feedback analog input signal. The value is in % where 20 mA = 100%

10.1.5 Advanced Parameters

NOTE Menu 1 through Menu 21 are only accessible via CTSOft or the SM Keypad Plus.

Pr	Function	Range	Units	Default	Type
1.21	HAND Mode Speed Setting	0 to Maximum Speed set in Pr 02	Hz	0	RW

Sets the fixed frequency that the motor will run when running in HAND Mode.

Pr	Function	Range	Units	Default	Type
1.23	No Flow RPM (Freq) Bandwidth	0 - 1500.0	Hz	15	RW

The Hz bandwidth setting used in No Flow Detection. The system monitors the motor frequency and if it is below the setting in Pr **68** (Pr **1.26**) +/- this bandwidth setting for the period of time set in Pr **2.23** the system proceeds with the No Flow Detection process.

Pr	Function	Range	Units	Default	Type
1.24	Minimum Sleep Speed/Freq	0 - 1500.0	Hz	0	RW

While running in PID, if the motor frequency falls below this level for the period of time set in Pr **2.17** and the pressure feedback is higher than the setpoint with bandwidth, the system will initiate sleep.

Pr	Function	Range	Units	Default	Type
1.25	Max Frequency Bandwidth	0 - 1500.0	Hz	1	RW

Sets the bandwidth of Pr **1.06** for determining when the drive is operating at maximum frequency. The system uses this during Under Pressure and Low Suction detection.

Pr	Function	Range	Units	Default	Type
1.26	No Flow RPM (Freq) Setpoint	0 - 1500.0	Hz	0	RW

In No Flow Detection, the system monitors the motor frequency and if it is below the setting in Pr **68** (Pr **1.26**) +/- the bandwidth in Pr **1.23** for the period of time set in Pr **2.23** the system proceeds with the No Flow Detection process.

Pr	Function	Range	Units	Default	Type
1.27	Transducer Loss Frequency	0 - 1500.0	Hz	0	RW

Set the running frequency when transducer loss is detection Pr **18.17** is set to 2.

Pr	Function	Range	Units	Default	Type
1.28	For Program Use				RO

10.1.6 Ramps and Timers

Pr	Function	Range	Units	Default	Type
2.13	Start Delay Time	0 - 3200.0	sec	0	RW


The system will delay activating the drive for a specified amount of time after the pressure transducer falls below the Low Setpoint or the Pressure Switch input turns on. If the transducer signal level rises above the Low Set-Point value or the Pressure Switch input turns off the timer will reset and the drive will remain inactive.

Pr	Function	Range	Units	Default	Type
2.14	Stop Delay Time	0 - 3200.0	sec	5	RW

In Pump Modes 1 and 2 the system will delay stopping the drive for a specified amount of time after the Flow Switch has closed. If the Flow Switch opens during this delay the timer will reset and the drive will remain active.

Pr	Function	Range	Units	Default	Type
2.15	Pipe Fill Time	0 - 3200.0	sec	0	RW

Upon starting in AUTO mode the motor will run at maximum frequency for the time specified by this parameter. After the time expires, normal PID operation will begin.

	<p>Care must be taken when setting this parameter because system over pressure can occur. Always set the Over Pressure Fault detection in Pr 18.21 when using this feature. A setting of 0 eliminates the Pipe Fill run time.</p>
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Pr	Function	Range	Units	Default	Type
2.16	Under Pressure Detect Time	0 - 3200.0	sec	0	RW

If the drive operates at the maximum frequency (set by bandwidth Pr **1.25**) for a period of time set in this parameter and the pressure remains below setpoint an Under Pressure fault will occur. A setting of 0 disables the fault detection.

Pr	Function	Range	Units	Default	Type
2.17	Sleep Start Time	0 - 3200.0	sec	0	RW

During PID operation if the drive speed falls below Minimum Sleep Speed Pr **67** (Pr **1.24**) for this specified amount of time, sleep will be initiated.

Pr	Function	Range	Units	Default	Type
2.18	Stabilize Delay	0 - 3200.0	sec	2	RW

During No Flow Detection the setpoint will be decremented by the % amount specified in Pr **18.27**. After the time set in Pr **2.18** elapses the setpoint will return to the original setting.

Pr	Function	Range	Units	Default	Type
2.23	Constant Frequency Time	0 - 3200.0	sec	5	RW

During No Flow Detection the system monitors the frequency of the motor. If it falls below Pr **1.26** (68) and bandwidth set by Pr **1.23** for the amount of time set in Pr **2.23** the system will decrement the setpoint for No Flow Detection.

Pr	Function	Range	Units	Default	Type
2.24	Dry Well Detection Time	0 - 3200.0	sec	0	RW

Sets the amount of time after the drive starts until the system checks for a Dry Well/Low Suction. A setting of 0 disables dry well detection.

Pr	Function	Range	Units	Default	Type
2.26	Speed/Torque Low Load Point	0 - 3200.0	0.10%	0	RW

Used in Dry Well Detection. This is the motor torque value threshold at maximum speed.

When the function is enabled the system compares the actual motor torque at maximum speed to this setting. If the actual torque is below this setting a Dry Well (unloaded pump) is detected.

Pr	Function	Range	Units	Default	Type
2.27	Low Suction Frequency Decrement	0 - 3200.0	0.10%	0	RW

The amount in % the setpoint will be reduced if a Dry Well/Low Suction condition is detected. Pr **18.18** must be set to 1 or the system will take other action.

10.1.7 Motor Settings

Pr	Function	Range	Units	Default	Type
5.07	Motor Rated Current	0 to Drive Rating	Amps	0	RW

The motor nameplate rated Current.

Pr	Function	Range	Units	Default	Type
5.08	Motor Rated RPM	0-9999	RPM	1800	RW

The motor nameplate rated Speed in RPM.

Pr	Function	Range	Units	Default	Type
5.09	Motor Rated Voltage	0 - 240 V, 0 - 480 V, 0 - 575 V, 0 - 690 V	Volts	Depends on the drive model	RW

The motor nameplate rated Voltage.

Pr	Function	Range	Units	Default	Type
5.10	Motor Rated Power Factor	0 - 1		0.850	RW

The motor nameplate rated Power factor. If unknown leave at default value or perform an auto-tune.

Pr	Function	Range	Units	Default	Type
5.14	Voltage Mode Select			FD	RW

Selects the type of voltage control used. Normally FD (fixed V/Hz with boost) is used. Further details are provided in the Commander SK User Guide.

10.1.8 Analog I/O

Pr	Function	Range	Units	Default	Type
7.06	Analog 1 Input Mode			4	RW

Defines the type of analog signal that is connected to terminal 2.

0	0-20	0 mA to 20 mA
1	20-0	20 mA to 0 mA
2	4-20	4 mA to 20 mA with trip on loss
3	20-4	20 mA to 4 mA with trip on loss
4	4-.20	4 mA to 20 mA with no trip on loss
5	20-.4	20 mA to 4 mA with no trip on loss
6	VoLt	0 to +10 volts

Pr	Function	Range	Units	Default	Type
7.10	Analog Input 1 Destination			0	RW

Maps the destination parameter that the pressure transducer signal will be sent to. For the Pump Solution system the signal is read directly by the program. Always set this parameter to 0.

Pr	Function	Range	Units	Default	Type
7.11	Analog Input 2 Mode			dig	RW

Defines the type of input for terminal 4 on the Commander SK drive. Always set to dig (digital).

Pr	Function	Range	Units	Default	Type
7.14	Analog Input 2 Destination			0	RW

Maps the destination parameter that the signal will be sent to. For the Pump Solution system the signal is read directly by the program. Always set this parameter to 0.

10.1.9 Digital I/O

Pr	Function	Range	Units	Default	Type
8.22	Terminal B4 Destination			18.31	RW

Maps the digital input on terminal B4 to the Pump Solutions program. Always set to 18.31, AUTO Mode Select Input.

Pr	Function	Range	Units	Default	Type
8.23	Terminal B5 Destination			18.32	RW

Maps the digital input on terminal B5 to the Pump Solutions program. Always set to 18.32, HAND Mode Select Input.

Pr	Function	Range	Units	Default	Type
8.24	Terminal B6 Destination			18.34	RW

Maps the digital input on terminal B6 to the Pump Solutions program. Always set to 18.34, Flow Switch Input.

Pr	Function	Range	Units	Default	Type
8.25	Terminal B7 Destination			18.35	RW

Maps the digital input on terminal B7 to the Pump Solutions program. Always set to 18.35, Pressure Switch Input.

10.1.10 System Status, Reset and Restart

Pr	Function	Range	Units	Default	Type
10.01	System Status			0 - 1	RO

Indicates a system fault when = 1.

Pr	Function	Range	Units	Default	Type
10.20	Last Trip				RO

Indicates the trip code for the most recent drive fault.

Pr	Function	Range	Units	Default	Type
10.33	Drive Reset	OFF(0) or ON(1)		OFF(0)	RW

Pr	Function	Range	Units	Default	Type
10.34	Auto Reset Times	0 - 5		5	RW

Defines the number of times the drive will attempt to automatically reset a fault.

Pr	Function	Range	Units	Default	Type
10.35	Auto Restart Times	0 - 25.0	sec	10	RW

Defines the amount of time in between automatic fault reset attempts.

10.1.11 Drive Configuration and Status

Pr	Function	Range	Units	Default	Type
11.27	Drive Configuration			Pr	RW

Sets the drive configuration mode i.e. the reference source location for the drive and I/O configuration. Always set this to Preset (Pr).



If this parameter is changed many other parameters will automatically change as a result. Therefore, set this to Pr and perform a drive reset prior to setting any other parameters.

Pr	Function	Range	Units	Default	Type
11.44	Security Status			L3	RW

This setting defines the level of security for menu 0 through the keypad.

Value	Level	Access permitted
0	L1	Only the first ten parameters can be accessed
1	L2	Parameters up to 60 can be accessed
2	L3	Parameters up to 95 can be accessed
3	LoC	Lock security, so that the security code must be entered before a parameter can be edited and set security status to L1

Pr	Function	Range	Units	Default	Type
11.47	PLC Ladder Program Enable			rUN/cLIP	RW

Defines how the Pump program will execute. Always set to Run with Clip.

10.1.12 Threshold Detector and Variable Selectors

Pr	Function	Range	Units	Default	Type
12.03	Threshold Detector 1 Source			15.40	RW

This parameter defines the parameter to be input to the programmable threshold.

Pr	Function	Range	Units	Default	Type
12.04	Threshold Detector 1 Level			10	RW

This parameter is the user defined threshold level entered as a percentage of the source maximum.

Pr	Function	Range	Units	Default	Type
12.07	Threshold Detector 1 Destination			18.39	RW

This parameter defines the parameter which is to be controlled by the threshold parameter. Only parameters which are not protected can be set up as a destination.

Pr	Function	Range	Units	Default	Type
12.08	Variable Selector 1 Source 1			7.01	RW

Pr	Function	Range	Units	Default	Type
12.10	Variable Selector 1 Mode			6	RW

Pr	Function	Range	Units	Default	Type
12.15	Pressure Transducer Filter			0	RW

10.1.13 Pressure PID Control

Pr	Function	Range	Units	Default	Type
14.02	PID Main Reference Source			18.29	RW

Maps the main reference to the PID loop. Always set to 18.29.

Pr	Function	Range	Units	Default	Type
14.03	PID Reference Source			18.05	RW

Maps the source reference signal to the PID loop. Always set to Pr 18.05.

Pr	Function	Range	Units	Default	Type
14.04	PID Feedback Source			12.12	RW

Maps the pressure feedback signal to the PID loop. Always set to Pr 12.12.

Pr	Function	Range	Units	Default	Type
14.10	Proportional Gain	0 - 4.000	Gain	1	RW

The pressure PID loop Proportional gain setting.

Pr	Function	Range	Units	Default	Type
14.11	Integral Time	0 - 4.000	sec	0.5	RW

The pressure PID loop Integral time setting.

Pr	Function	Range	Units	Default	Type
14.12	Differential Rate	0 - 4.000	d/dt	0	RW

The pressure PID loop Differential rate setting.

Pr	Function	Range	Units	Default	Type
14.14	PID Lower Limit			0	RW

The low limit for the pressure PID loop output.

Pr	Function	Range	Units	Default	Type
14.16	PID Output Destination			1.36	RW

Maps the output of the pressure PID loop to the drive speed reference signal. Always set to 1.36.

10.1.14 I/O Expansion

These parameters are used to set up the SM-I/O Lite module.

Pr	Function	Range	Units	Default	Type
15.24	Terminal T5 Destination			18.36	RW

Maps digital input terminal 5 of the SM-I/O Lite module. Always set to 18.36.

Pr	Function	Range	Units	Default	Type
15.25	Terminal T6 Destination			18.37	RW

Maps digital input terminal 6 of the SM-I/O Lite module. Always set to 18.37.

Pr	Function	Range	Units	Default	Type
15.26	Terminal T7 Destination			10.33	RW

Maps digital input terminal 7 of the SM-I/O Lite module. Always set to 10.33.

Pr	Function	Range	Units	Default	Type
15.27	Terminal T21/T23 Relay Source				RW

Maps the output relay of the SM-I/O Lite module to the signal of choice.

Pr	Function	Range	Units	Default	Type
15.38	Analog Input T2 mode			Volt	RW

Defines the type of input for terminal 2 of the SM-I/O Lite module. Always set to Volt.

10.1.15

Pump Control

Indicates the scaled pressure feedback in PSI. indicates the PID loop error.

Pr	Function	Range	Units	Default	Type
18.01	For Program Use (NV)	± 32767			RO

Pr	Function	Range	Units	Default	Type
18.02	Pressure Feedback Value	± 32767	0.1 PSI		RO

Indicates the scaled pressure feedback PSI

Pr	Function	Range	Units	Default	Type
18.03	PID	± 32767	0.1 PSI		RO

Indicates the pressure PID loop error

Pr	Function	Range	Units	Default	Type
18.04	Selected Pressure Setpoint Value	± 32767	0.1 PSI		RO

Indicates the selected user pressure setpoint value.

Pr	Function	Range	Units	Default	Type
18.05	Scaled Pressure Setpoint for PID	± 32767	P.U.		RO

Indicated the scaled pressure PID setpoint.

Pr	Function	Range	Units	Default	Type
18.06	For program use	± 32767			RO

Pr	Function	Range	Units	Default	Type
18.07	For program use	± 32767			RO

Pr	Function	Range	Units	Default	Type
18.08	Final Pressure Setpoint with Inc & Dec	± 32767	0.1 PSI		RO

Indicates the pressure setpoint after being incremented or decremented for detection purposes.

Pr	Function	Range	Units	Default	Type
18.09	For program use	± 32767			RO

Pr	Function	Range	Units	Default	Type
18.10	For program use	± 32767			RO

Pr	Function	Range	Units	Default	Type
18.11	Pumping Macro Select	± 32767		0	RW

Defines the Operation Mode of the Pump system.

0 = Off

1 = Terminals

2 = Keypad, Automatic Only

3 = Keypad, Automatic and Hand

Pr	Function	Range	Units	Default	Type
18.12	Start/Stop & Control Mode	± 32767		3	RW

This parameter sets the Start/Stop mode of the drive.

1 = Pressure Start/Flow Stop. The drive will start when the feedback pressure switch closes and runs until a stop command is given or a no flow detection is received from the No Flow switch input.

2 = Pressure Transducer/Flow Switch. The drive will start when the feedback pressure transducer level is below the Low Setpoint (Pr 18.13), and runs until a stop command is received or a no flow detection is made from the No Flow switch input.

3 = Pressure Transducer. The drive will start when the feedback pressure transducer level is below the Low Setpoint (Pr 18.13), and runs until a stop command is given or a No Flow detection is received (see No Flow diagram for details).

Pr	Function	Range	Units	Default	Type
18.13	Low Pressure Setpoint	± 32767	0.1 PSI	0	RW

Set this parameter to the pressure at which the drive will begin to run in Modes 2 and 3 (set by Pr 63 (Pr18.12)).

Pr	Function	Range	Units	Default	Type
18.14	Under Pressure Setpoint	± 32767	0.1 PSI	0	RW

Pr	Function	Range	Units	Default	Type
18.15	Pressure Setpoint Bandwidth	± 32767	0.1 PSI	5	RW

Used in No Flow Detection. After decrementing the pressure setpoint the feedback is monitored to determine if it is within this bandwidth of the setpoint. If it is the original setpoint is restored. If not a No Flow condition is detected.

Pr	Function	Range	Units	Default	Type
18.17	Transducer Loss Action	± 32767		1	RW

Sets the action taken in the event of a transducer signal loss.

0 = Disabled

1 = Fault Drive

2 = Run at a fixed speed set by Pr 1.21

Pr	Function	Range	Units	Default	Type
18.18	Dry Well Detection Model	± 32767		2	

Sets the action taken in the event of a Dry Well Detection.

0 = Alarm

1 = Decrease Speed

2 = Fault

Pr	Function	Range	Units	Default	Type
18.20	Over Pressure Alarm Level	± 32767	0.1 PSI	0	RW

If the pressure feedback signal rises above this setting the Over Pressure Alarm digital output will turn on.

Pr	Function	Range	Units	Default	Type
18.21	Over Pressure Fault Level	± 32767	0.1 PSI	0	RW

If the pressure feedback exceeds this setting the drive will fault and trip code 82 will be indicated.

Pr	Function	Range	Units	Default	Type
18.22	Minimum Pressure Feedback Scaling	± 32767	0.1.PSI	0	RW

Sets the scaling in PSI for the minimum pressure reading of the feedback transducer.

Pr	Function	Range	Units	Default	Type
18.23	Maximum Pressure Feedback Scaling	± 32767	0.1 PSI	1450	RW

Sets the scaling in PSI for the maximum pressure reading of the feedback transducer.

Pr	Function	Range	Units	Default	Type
18.24	Alternate Pressure Setpoint 1	± 32767	0.1 PSI	0	RW

This is the Alternative 1 PSI setpoint for the system. If the optional SM-I/O Lite module is installed, 3 alternative setpoints may be selected with digital inputs.

Main Setpoint = Terminal 5 and 6 open

Setpoint 1 = Terminal 5 closed, 6 open

Setpoint 2 = Terminal 5 open, 6 closed

Setpoint 3 = Terminal 5 and 6 closed

Pr	Function	Range	Units	Default	Type
18.25	Alternate Setpoint 2	± 32767	0.1 PSI	0	RW

This is the Alternative 2 PSI setpoint for the system. If the optional SM-I/O Lite module is installed, 3 alternative setpoints may be selected with digital inputs.

Main Setpoint = Terminal 5 and 6 open

Setpoint 1 = Terminal 5 closed, 6 open

Setpoint 2 = Terminal 5 open, 6 closed

Setpoint 3 = Terminal 5 and 6 closed

Pr	Function	Range	Units	Default	Type
18.26	Alternate Setpoint 3	± 32767	0.1 PSI	0	RW

This is the Alternative 3 PSI setpoint for the system. If the optional SM-I/O Lite module is installed, 3 alternative setpoints may be selected with digital inputs.

Main Setpoint = Terminal 5 and 6 open

Setpoint 1 = Terminal 5 closed, 6 open

Setpoint 2 = Terminal 5 open, 6 closed

Setpoint 3 = Terminal 5 and 6 closed

Pr	Function	Range	Units	Default	Type
18.27	Setpoint Decrement	± 32767	0.1 PSI	10	RW

While operating in PID the drive monitors the motor frequency. If the frequency falls below the setpoint (1.26 (68)) with bandwidth (1.23) for the time period specified (2.23) the setpoint will be decremented by this percentage as a step toward detecting no flow.

Pr	Function	Range	Units	Default	Type
18.27	Software Version	± 32767			RO

Indicates the Pump Solutions program version number.

Pr	Function	Range	Units	Default	Type
18.29	PID Saturate	± 32767			RO

Used in the Pipe Fill feature for saturating the PID loop. Is set to 32767 during pipe filling time and is set to 0 during normal PID operation.

Pr	Function	Range	Units	Default	Type
18.30	Main Setpoint	± 32767	0.1 PSI	0	RW

The main pressure setpoint for the system to maintain, entered in PSI.

Pr	Function	Range	Units	Default	Type
18.31	AUTO Mode Select Digital Input	0 - 1		0	RO

This bit selects AUTO mode when =1. Terminal B4 is normally mapped to this bit through Pr 8.22 so that the digital input controls the turning on and off of AUTO mode.

Pr	Function	Range	Units	Default	Type
18.32	HAND Mode Select Digital Input	0 - 1		0	RO

This bit selects HAND mode when =1. Terminal B5 is normally mapped to this bit through Pr 8.23 so that the digital input controls the turning on and off of HAND mode.

Pr	Function	Range	Units	Default	Type
18.33	Pipe Fill Time Done	0 - 1		0	RO

Indicates the Pipe Fill Time is elapsed when = 1.

Pr	Function	Range	Units	Default	Type
18.34	Flow Switch Digital Input	0 - 1		0	RO

Terminal B6 is normally mapped to this bit through Pr 8.24 so that the digital input indicates to the program when the flow switch is on.

Pr	Function	Range	Units	Default	Type
18.35	Pressure Switch Digital Input	0 - 1		0	RO

Terminal B7 is normally mapped to this bit through Pr 8.27 so that the digital input indicates to the program when the pressure switch is on.

Pr	Function	Range	Units	Default	Type
18.36	Multi-set p1 Digital Input	0 - 1		0	RO

Indicates the state of Multi-set p1 input on terminal 5 of the SM-I/O Lite module. The input is mapped to this bit by Pr 15.24.

Pr	Function	Range	Units	Default	Type
18.37	Multi-set p2 Digital Input	0 - 1		0	RO

Indicates the state of Multi-set p2 input on terminal 6 of the SM-I/O Lite module. The input is mapped to this bit by Pr 15.25.

Pr	Function	Range	Units	Default	Type
18.38	Pump Fault Digital Input	0 - 1		0	RO

Indicates the state of the Pump Fault input on terminal 4 of the Commander SK drive.

Pr	Function	Range	Units	Default	Type
18.39	Over Temperature Digital Input	0 - 1		0	RO

Indicates the state of the Over Temp. input on terminal 2 of the SM-I/O Lite module.

Pr	Function	Range	Units	Default	Type
18.40	System Ready Digital Status	0 - 1		0	RO

Indicates the system is ready to run (no faults) when = 1. Can be used as the source parameter for any output.

Pr	Function	Range	Units	Default	Type
18.41	Over Pressure Warning Digital Status	0 - 1		0	RO

Indicates an over pressure warning when = 1. Can be used as the source parameter for any output.

Pr	Function	Range	Units	Default	Type
18.42	Within Max. Frequency Bandwidth Status	0 - 1		0	RO

Indicates the drive is running within the bandwidth setting of the maximum frequency when = 1. Can be used as the source parameter for any output.

Pr	Function	Range	Units	Default	Type
18.43	At Reference Digital Output Status	0 - 1		0	RO

Indicates the system is running at the reference (setpoint) speed when = 1. Can be used as the source parameter for any output.

Pr	Function	Range	Units	Default	Type
18.44	Transducer Loss Digital Output Status	0 - 1		0	RO

Indicates a feedback transducer signal loss when = 1. Can be used as the source parameter for any output.

Pr	Function	Range	Units	Default	Type
18.45	Drive Running is AUTO Status	0 - 1		0	RO

Indicates the system is running and in AUTO mode when = 1. Can be used as the source parameter for any output.

Pr	Function	Range	Units	Default	Type
18.46	Dry Well/Low Suction Output Status	0 - 1		0	RO

Indicates the system has detected a Dry Well condition when = 1. Can be used as the source parameter for any output.

Pr	Function	Range	Units	Default	Type
18.47	AUTO Mode Selected Status	0 - 1		0	RO

Indicates the system is in AUTO Mode when =1.

Pr	Function	Range	Units	Default	Type
18.48	HAND Mode Selected Status	0 - 1		0	RO

Indicates the system is in HAND Mode when =1.

Pr	Function	Range	Units	Default	Type
18.49	Spare	0 - 1		0	

Pr	Function	Range	Units	Default	Type
18.50	Spare	0 - 1		0	

This parameter selects the source for the under pressure setpoint. =0.

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Pr	Function	Range	Units	Default	Type
21.08	Reserved for program use				RO

11 Diagnostics

11.0.1 Fault Trip Codes

In the event of a trip the drive keypad will display a trip code to indicate the fault. Below are the trip codes specific to Pump Solutions related faults. The Commander SK drive trip codes can be found in the Commander SK Getting Started Guide.

Pr **10.20** through Pr **10.29** display the last 10 trips in the drive with Pr **10.20** being the most recent and Pr **10.29** the oldest.

ACTIVE FAULT

Tr81 = Feedback Loss Fault

Tr82 = Over Pressure Fault

Tr83 = Under Pressure Fault

Tr84 = Dry Well/Broken Shaft Fault

Tr85 = External Pump Fault

Tr86 = Spare

Tr87 = Over Temperature Fault Input

11.0.2 Alarm Indicator Parameters

10.01 Fault Indicator

18.40 Ready for Operation (no fault)

18.41 Over Pressure Warning

18.43 At Set Point Indicator

18.44 Transducer Loss Indicator

These are binary indicators where a value of 1 = an alarm or fault is present.

11.1 Resetting Trips

11.1.1 Automatic Reset

If Pr **10.34** is set to zero then no auto reset attempts are made. Any other value will cause the drive to automatically reset following a trip for the number of times programmed. Pr **10.35** defines the time between the trip and the auto reset (this time is always at least 10s for OI.AC, OI.br trips, etc.). The reset attempt count is only incremented when the trip is the same as the previous trip, otherwise it is reset to 0. When the reset count reaches the programmed value, any further trip of the same value will not cause an auto reset. If there has been no trip for 5 minutes then the reset count is cleared. Auto reset will not occur on UU, Et, EEF or HFxx trips. When a manual reset is performed the auto reset counter is reset to zero.

11.1.2 Manual Reset

Pressing the Stop/Reset (red) button on the drive keypad will attempt to reset all fault conditions.

If the optional SM-I/O Lite module is installed input terminal 7 is designated as the fault reset. An external push button or other device may be connected to reset trips.

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